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THE NAVAL AVIATION SAFETY REVIEW

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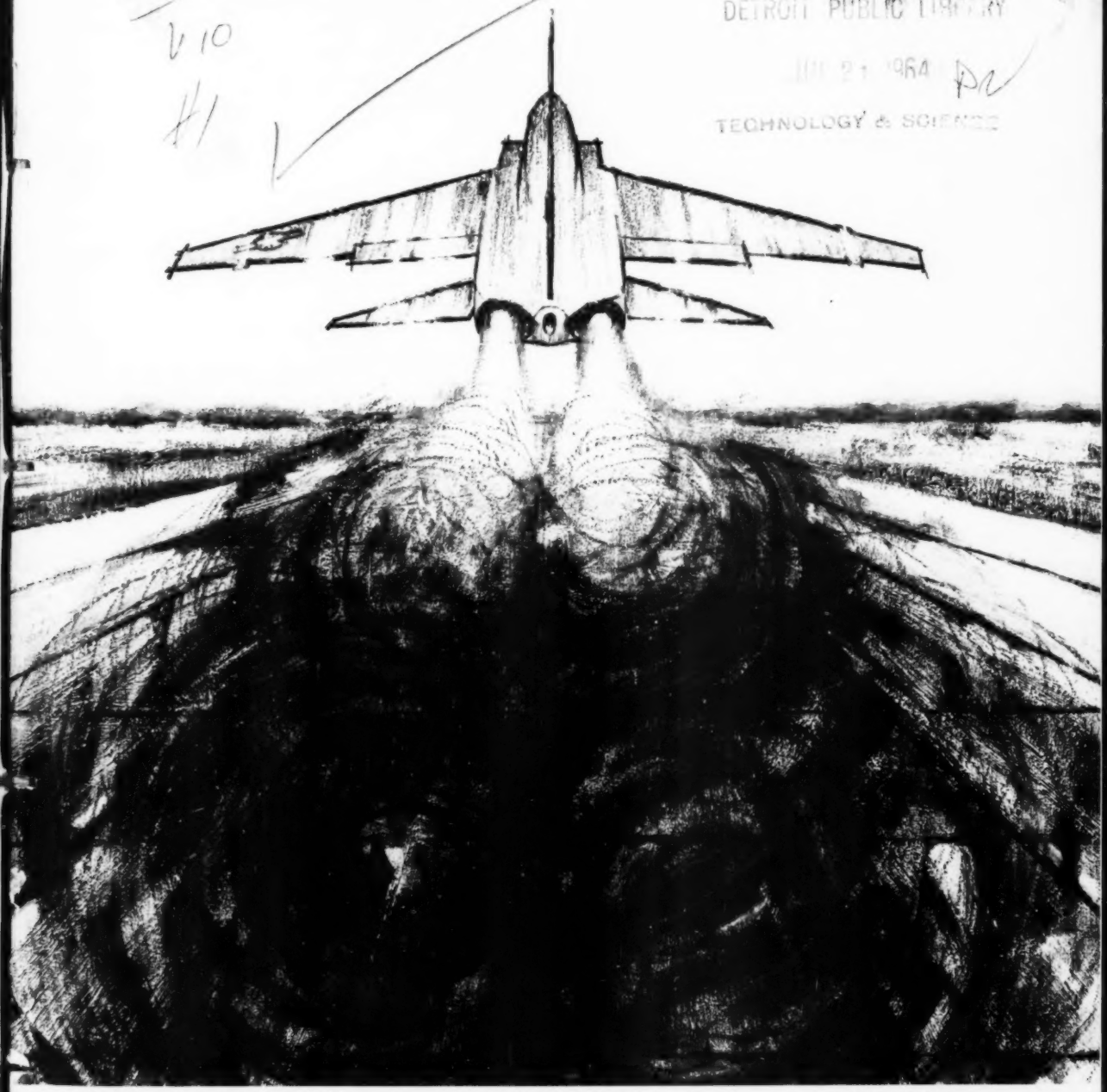


DITCH or EJECT? / LANCE STERLING returns / J79 CSD care

DITCH or EJECT

By LCDR F. J. Pester, NASC

Probably the most harrowing situation a tailhook aviator is confronted with today is when he finds himself sliding across a flight deck knowing his aircraft is not going to fly. Or, having struck the rounddown, knowing that a collision with the water is imminent.

Under these circumstances, the pilot is immediately called upon to make a decision—the most important decision he will ever make in his life: *eject or ride the aircraft into the water.*

The decision to eject should not be a difficult decision to make when the pilot knows his aircraft is within the designed escape envelope. But in a situation of taxiing or slowly sliding off the flight deck, "cold cat" shot or ramp strike he may find himself at the lower limits or even below the designed escape envelope.

Either he must ask the escape system to perform beyond its capabilities, or he must ask the aircraft

F-8 Pilot chose to eject outside ejection envelope. Chut

to remain glued together after striking the water with tremendous force. Faced with this dilemma, he is forced to choose a course of action with a relatively unpredictable outcome. The escape system was not designed to operate at low airspeed-high sink rate conditions, and an aircraft was not designed for the sole purpose of withstanding the forces encountered in water collision.

We shall attempt to assist the pilot in making his decision by listing theoretical advantages and disadvantages of the "out of the envelope" ejection and ditching. A review of past situations will give an indication of survivability.

Remaining With Aircraft

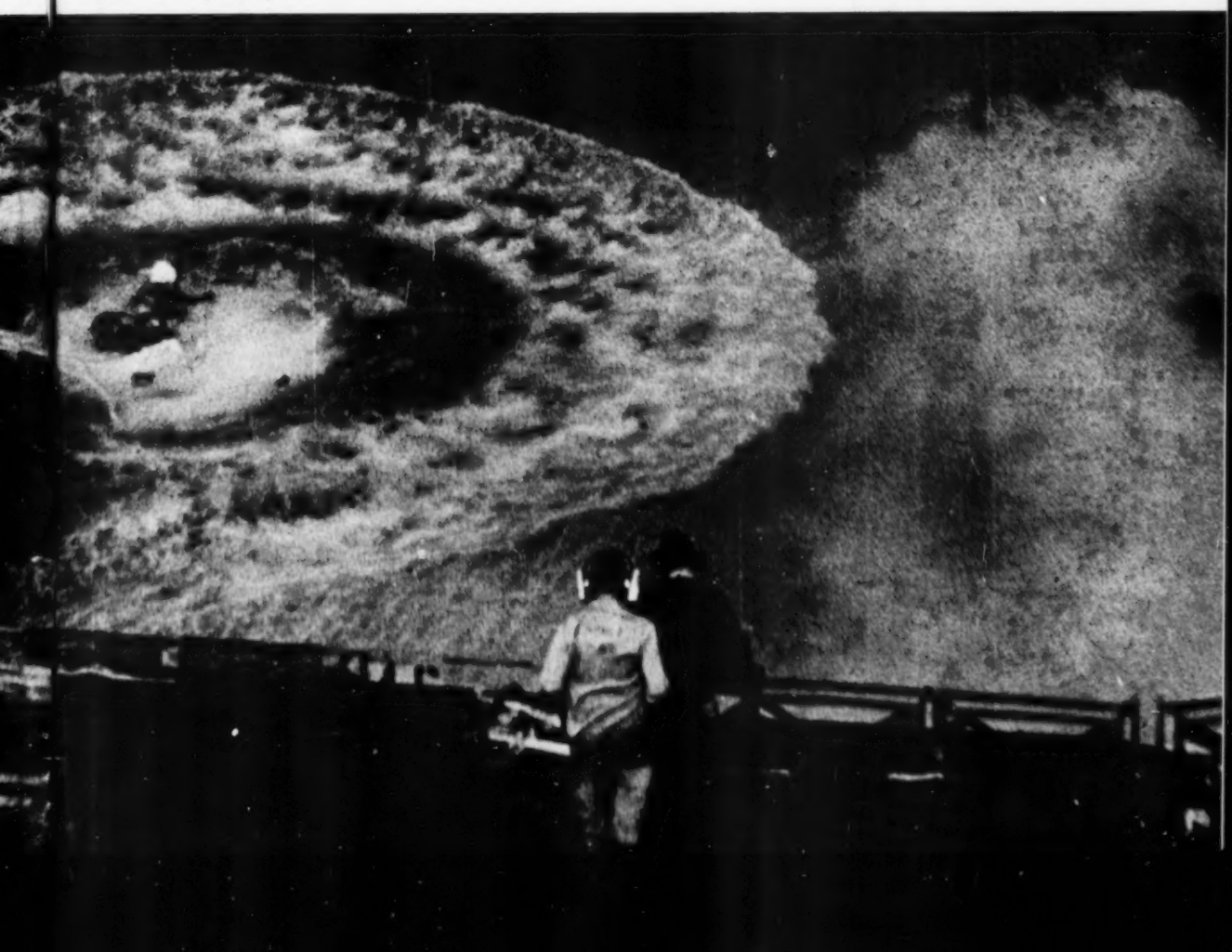
Theoretical Advantages:

- Upon impact with water the aircraft nose structure will absorb energy in breaking up and provide a less rapid rate of deceleration.
- The cockpit will afford water impact protection for the pilot's body.
- The torso harness restraint system will spread deceleration forces over a comparatively large area of the body.

Theoretical Disadvantages:

- The pilot must jettison canopy, preferably prior to water impact. He may be unable to do so after water collision because of impact damage.
- After impact, pilot must rapidly disconnect and egress.
- The pilot must retain mental and physical ability to rapidly evacuate the aircraft.
- If the pilot does not evacuate the aircraft unaided, it is highly improbable that helo rescue personnel will be able to reach and assist him before the aircraft sinks.
- There is a possibility of entanglement in the cockpit during egress.
- Large jet engine intakes afford high decelera-

Chute did not fully deploy.



tive "G" onset rate to the aircraft.

Ejecting Out of Envelope

Theoretical Advantages:

- Partial or nearly full parachute deployment may provide less impact speed than aircraft experiences.
- The pilot is not confronted with cockpit evacuation problems.
- The pilot is readily accessible for immediate rescue.

Theoretical Disadvantages:

- At lower airspeeds, ejectee may contact water at greater velocity than aircraft due to added trajectory height.
- There is little protection for the body against impact forces.
- The pilot must retain mental and physical ability to release rocket jet fittings, inflate life preserver and remain afloat.

I am sure that the apparent advantages and disadvantages listed above have been cussed and discussed in every readyroom by every aviator who has flown in an ejection-seat-equipped aircraft. Unfortunately, little information concerning decelerative forces involved in water impact with partially opened parachutes or jet aircraft in different attitudes and airspeeds is available. Therefore, let us turn to the experience of others who have been faced with the decision to eject or ditch.

Tables I through III list all Martin-Baker and RAPEC ejection-seat-equipped aircraft accidents wherein carrier embarked aircraft went over the side during the period of 1 January 1960 to 1 July 1963. Table I covers aircraft that went over the side due to loss of brakes and/or traction resulting in taxiing or skidding off the flight deck. Table II covers aircraft water collisions following some malfunction encountered during the catapult shot. Table III covers aircraft water collisions following ramp strikes, deck crashes or arresting gear failure. Conditions are briefly stated at the time the pilot either ejected or collided with the water if he remained in aircraft. Airspeeds are water impact speed or ejection speed, as applicable.

Injury codes are:

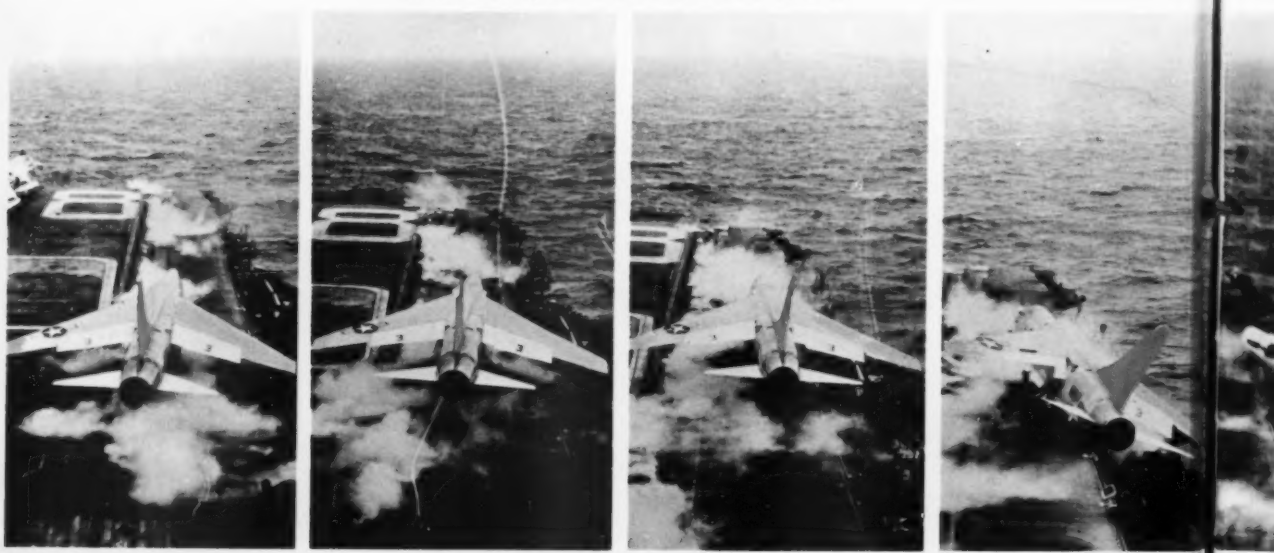
A—Fatal	D—Minor
B—Critical	E—No Injury
C—Serious	L—Lost and Presumed Drowned

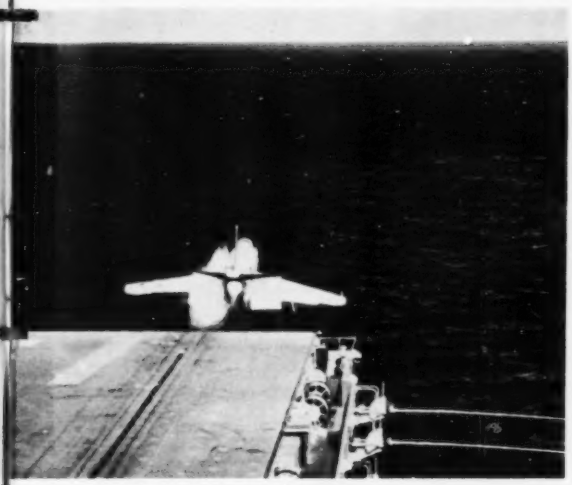
TABLE I

Injuries sustained as result of skid or taxi off flight deck

Remained in A/C	Ejected	Remarks
		F-8
	C	0-10 kts/50 ft.—Over the side during taxi off catapult
C		30-40 knots—Off catwalk inverted
L		30-40 knots—Taxied off flight deck

What would be your choice of action in this situation?





Moment of decision

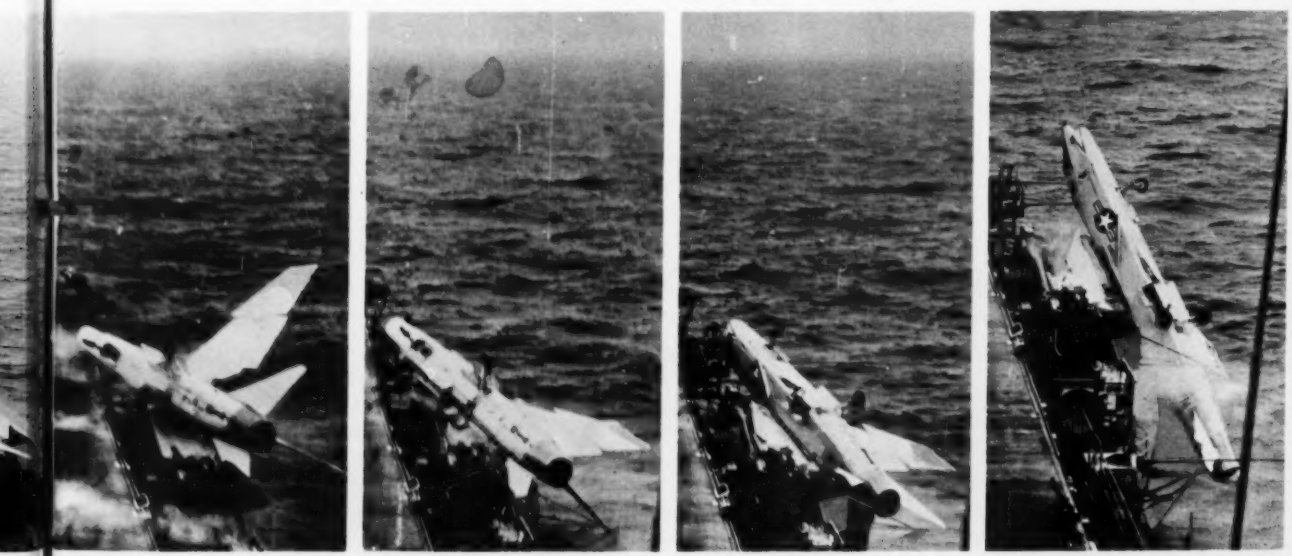
	F-3	
C		30-40 knots—Brake failure, over the side inverted
L		30-40 knots—Off flight deck, hit gun tub, then water
	A-4	
E		30-40 knots—Skidded off flight deck coming out of gear
E		30-40 knots—Lost brakes, dropped off angle deck

Table I indicates that the chances of surviving the ditchings are relatively good when water impact speed is low. Since there was only one ejection resulting from skid off the flight deck this can not be interpreted as the best course of action in all cases. It is emphasized that this ejectee contacted the water with only the controller and stabilizer drogue chutes deployed and that he was exceptionally well trained in procedures to follow after ejection. Although unable to see clearly due to eye injuries, this pilot released his rocket jet fittings, inflated his life vest and boarded the helo rescue seat without difficulty.

TABLE II

Injuries sustained immediately following catapult stroke

Remained in A/C	Ejected	Remarks
		F-8
	L	10 kts/70ft-90° bank—Landing gear failed on cat stroke
	L	90 kts/0 ft-nose high—Insufficient end speed
	L	50 kts/15 ft-nose down-inverted—Insufficient end speed
L		140 kts-nose low 90° bank—Wing folded on cat shot
L		75 kts-nose high-wings level—Cat pendant separated
D		70 kts-nose down-wings level—Hold back unit failed



L		70 kts-nose down-wings level—Insufficient end speed
L		130 kts-nose down-inverted—Wings folded
L		30 kts-nose down 90° bank—Aircraft separated from cat hold back
		F-6
A		55 kts-flat—Insufficient end speed
		F-4
	D	30 kts/70 ft-nose down—Insufficient end speed
	L	40 kts/0 ft-nose down—Insufficient end speed
	D	80 kts/150 ft-nose down—Disorientation off cat
L		80 kts—Disorientation off cat
		F-3
	A	120 kts/0 ft-flat—Engine malfunction
	L	159 kts/0 ft-level—Engine malfunction
	D	120/10 ft-level—Engine malfunction
D		110 kts-nose high—Engine shifted aft
L		130 kts-level—Flew into water
L		20 kts-inverted—Insufficient end speed
		F-1
	D	80 kts/30 ft-level—Settled off cat
	D	150 kts/100 ft-20° bank—Wings folded
L		140 kts-level—Parachute deployed on cat shot
		A-4
	L	130 kts/0 ft-nose high-level—Settled in
L		120 kts-level—Settled in
L		130 kts-nose down—Insufficient end speed
L		120 kts-nose high-level—Insufficient end speed
L		120 kts-flat—Insufficient end speed
D		60 kts-nose down-left wing down—Bridle broke
L		130 kts-left wing down—Settled in

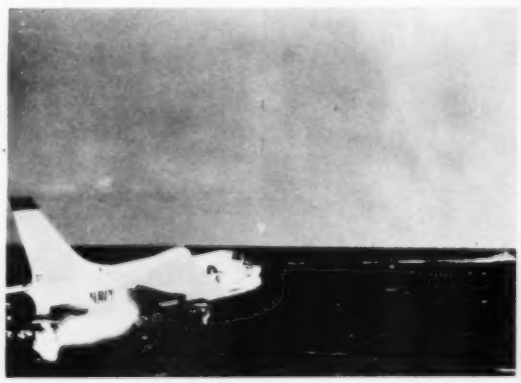
Probably the most important information to be obtained from Table II is that the cold cat shot or the sink-off-bow is the least survivable situation with which an aviator can be confronted. It does indicate, however, that when this situation occurs the ejection has resulted in a higher percentage of "saves" than when the pilot stayed with the aircraft. It also indicates that if the pilot waits until zero altitude to eject, he has waited too long. All of the successful ejections had *some* altitude.

The higher fatality rate that occurred in this situation, as compared to the skid or taxi off flight deck type accident, may be attributed to the increased water collision speed. Note that of the three survivors in the ditching situation, two survived the slower airspeed ditchings.

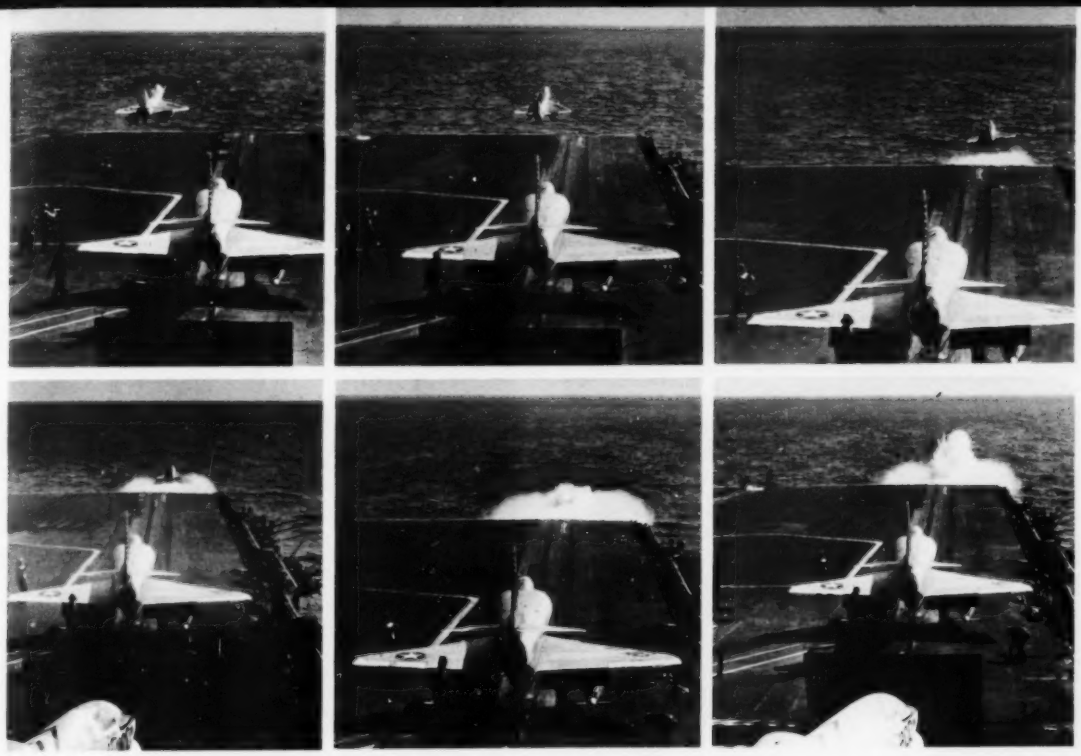
TABLE III

Injuries sustained immediately following ramp strike, deck crash or arresting gear failure

Remained in A/C	Ejected	Remarks
		F-9
	L	90 kts/0 ft-left wing down—Broken A. G. pendant
		F-8
	D	10 kts/390 ft—Stall climb after ramp strike
	D	120 kts/70 ft-nose down-right bank—Deck crash
	C	120 kts/50 ft-nose down—Ramp strike
	D	120 kts/65 ft-nose down—Deck crash
	A	130 kts/0 ft-ramp strike—Pilot landed on CV deck
	E	60 kts/200 ft-right wing down—Ramp strike



Time to act



Cold Cat Shot, RAPEC seat installed—not used

	D	110 kts/20 ft-sliding down deck—Ramp strike
	L	110 kts-nose low-left wing down—Ramp strike
	L	110 kts-inverted—Slide off bow of angle deck—Ramp strike
	D	95 kts—Through barricade
	L	130 kts-nose high—Ramp strike
		F-6
	L	130 kts-flat—Ramp strike
		F-3
	D	80 kts/65 ft-wing down—Ramp strike
	L	90 kts-nose down-inverted—Ramp strike
		A-4
	D	160 kts/25 ft-nose high-left bank—Broken A.G. pendant
	L	115 kts-nose up-level—Ramp strike

The one survivor of those aircraft that went in the water with the pilot aboard, from Table III, was from an aircraft that went through the barricade. Compared to the number of successful ejections, the one successful ditching indicates ejection is the best course of action *if* action is taken soon enough. It appears logical that this would be true because normally the conditions encountered in ramp strikes or deck crashes are more favorable and dictate ejection rather than ditching. These conditions are: (1) Airspeed normally above stall: (2) Sink rate stopped by the flight deck; and (3) Possibility exists to climb after the deck crash. (Two of the successful ejections were well above flight deck level.)

Again in Table III, the *unsuccessful ejections occurred at the lower altitudes indicating that a delay or hesitation in initiating the ejection plays a very important part in the outcome.* The high rate of non-survivability of those who remained in the aircraft in this category (highest of all three tables) is considered in part due to the possibility of partial pilot incapacitation suffered from ramp strike impact forces prior to impact of the aircraft with the water.

So What?

We have reviewed the theory; we have reviewed the statistics. In our own experience we have witnessed ditchings wherein the pilot did not survive and we asked ourselves, "Why didn't he eject?" Conversely, we have witnessed ejections that had unsuccessful outcomes and watched an apparently in-

tact cockpit float by the ship and thought, "If he had ridden her in . . ." What, then, if any, conclusions can be reached from the information available?

First, we must conclude that timeliness of action is a most important factor. We must crank as much input as possible into this computer we carry on our shoulders—nature of emergency, airspeed, altitude, attitude, roll rate, control availability—and we must come up with the best solution. Normally in these types of emergencies time is of the essence because as time elapses, available altitude, airspeed and acceptable ejection attitude are deteriorating rapidly. The longer it takes to make the decision, the smaller are the chances for successful ejection.

Like it or not, we are automatically eliminating one course of action and committing ourselves to ditching. Notice that in all of the cases listed what an important part airspeed plays. The higher the airspeed, the greater are the chances for successful ejection and, as shown in the Ditching Airspeed Summary (Chart I), the lower are the chances for

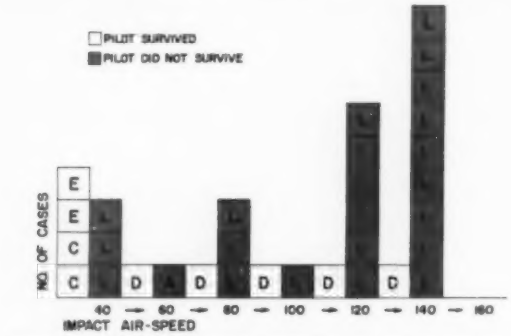


CHART I A/C WATER IMPACT AIRSPEED vs SURVIVABILITY

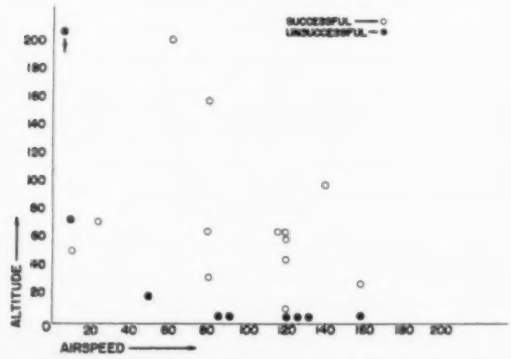


CHART II EJECTION AIRSPEED AND ALTITUDE - SURVIVABILITY

successful ditching. From the ejections in the Summary Chart (Chart II), we see how very important it is to eject while you have some altitude.

Improving Escape Equipment

By the very nature of the emergencies encountered during carrier operations, we may very readily determine that there is an urgent requirement for an improved ejection envelope. Although our present modern ejection seats are quoted for ground level at low airspeeds, *this assumes near level attitude and no sink rate.* A quick look at your ejection envelope charts in the flight manuals shows how dive angle, bank angle and sink rate detrimentally affect ejection seat performance. Extremes of attitude (roll or pitch) will vary the maximum ejection height due to the ejection line of the seat being vectored away from the vertical. Taken about the pitch axis, these changes will also affect the velocity of the ejected seat. For example, a maximum upward ejection catapult velocity of 80 ft/sec would be countered by the aircraft descending at the same rate. This represents an aircraft glide slope of only 18 degrees at 150 knots. High priority programs are now underway to improve ejection seat performance to provide zero capability. This will provide a much greater ejection envelope under adverse conditions such as low airspeed and high sink rates.

Because of the low number of successful underwater escapes from ditched aircraft, we must conclude also that there is an *urgent* requirement for an underwater ejection capability. It is difficult enough to egress from a cockpit on land, but underwater the problems are magnified. Besides being possibly stunned and to some degree in a state of panic, a potential survivor has the problems of canopy removal, breathing, poor visibility and entanglement. At least two underwater ejections have been performed successfully in the Navy. (See APPROACH, June 1957, p. 21 "Over, Under and Out!" and May, 1962, p. 11, "I Ejected Underwater.")

The Aerospace Crew Equipment Laboratory at Philadelphia has been experimenting with underwater ejection systems and it is hoped that this capability will be a proven reality in the near future.

Training is a Key

With our present system we may conclude also that *the training one has had to meet the emergency will play a very important part in the outcome.* If you have elected to ditch you must start taking action immediately. Try to get rid of the canopy prior to contact with the water. Remember that impact damage could cause your normal canopy jettison system to malfunction. After the aircraft is submerged, an undamaged canopy is difficult to separate while the cockpit is full of air because the hydrostatic pressure will tend to hold the canopy closed at lower depths until the cockpit is flooded. With the high submersion rate of jet aircraft you may be very deep before this occurs.

If you anticipate ejection, you must train for the action you will take after you hit the water. Train so you will automatically inflate your vest and shed your chute. Know how to get into your raft and how to use the helo rescue sling and seat.

Making the Decision

In conclusion, the decision to eject or ditch *has been, is,* and *will be yours* to make. I believe you'll agree that this is one that the NATOPS Manual can not make for you. So until the time comes when we don't have brake failures, slippery decks, cold cat shots, broken arresting gear wires or carrier ramps that are just a hair too high, you will be faced with making the decision. It is hoped that the information presented here will assist you in making the correct one.

LCDR F. J. Pester entered flight training in June 1948 and received his wings in January 1950. He was selected for jet training at Whiting Field where he flew single place F-80s.

LCDR Pester is a veteran of two Korean combat cruises as a member of Fitron 112 flying Panthers from the USS PHILIPPINE SEA (CV-47) and the USS KEARSARGE (CV-33). His career includes a tour of duty at the Advanced Training Command flying F-9F and T-33s, flight deck officer aboard the USS LAKE CHAMPLAIN (CV-39), VX-3 flying F-6s and F-8s.

LCDR Pester holds a Bachelor of Science degree and is a graduate of both the Aviation Safety Officers' Course at the University of Southern California and the U. S. Naval Postgraduate School. He is currently assigned to the Biophysics and Survival Division of the Aero-Medical Department of the Naval Aviation Safety Center.

TO GO OR NOT TO GO?

By LT G. W. Lubbers, USN

Many theories and ideas have been expressed on decreasing the hazards involved and improving procedures and techniques for operating aircraft off aircraft carriers. As a result of this intense effort, the number of carrier landing accidents has generally lessened as we advance the state of the art.

Not so, however, the carrier launching accidents. Over the fiscal years 1959 through 1963 the total number of CV accidents has dropped, but the number of takeoff accidents has generally risen.

In a majority of the accidents the primary cause has been material failure—either aircraft or catapult. Running a close second is pilot error. These errors span the gamut from improper preflight to disorientation after the catapult shot. No matter what the cause, the predominant outcome was a plane in the water.

The pilot's reaction to such a situation must be viewed in light of his carrier experience and the existing conditions. When he perceives abnormal movement on the catapult, he is faced with the need for an immediate assessment of the situation. His actions may vary—depending upon whether or not the holdback has released prior to firing, the catapult has fired but is not providing required acceleration or the catapult has fired but the bridle has become separated from the aircraft. It would be a monumental task to attempt a brief on all possible malfunctions that may occur during catapult operations. In any given instance, the pilot's reflex action is the only suitable response to a unique situation.

To aid pilots in making the decision to attempt to stop or go-for-broke, a simple criterion leading to one of two actions has been suggested by an endorser of a fatal catapult accident.

- "If the pilot moves ahead but feels no significant initial acceleration he will move the throttle to idle and commence braking.
- "On the other hand, if substantial initial acceleration is experienced he will use maximum power to go off the bow with as much speed as possible.

"Other considerations such as seeing the shuttle ahead of the aircraft, feeling it strike the nose wheel, or observing the nose rise are often mentioned in general discussions of this subject. These only tend to confuse the pilot and *are not decisive in selecting the proper response.* The strength of *the initial acceleration is the only indication which gives the pilot positive evidence* as to his chances of stopping the aircraft and it is the nature of the initial acceleration that the pilot must concentrate upon at the moment of launch." (Italics supplied—Ed.)

It is impossible to teach one response to an incident, which having a multitude of variables, will also have a wide range of results.

The pilots involved in the following two accidents made an evaluation of their situation, reasoned out their response and performed the required action in a fraction of an instant to pull themselves out of a perilous situation. There was no prebriefed response, no standardized procedure—just quick thinking.

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CASE ONE

"On the night of 7 January I was scheduled for a night tanker hop. This was my second hop of the day. I briefed with the pilots going on my launch and refreshed myself on tanker procedures. At 1930 I went to the flight deck and preflighted the aircraft. I went through a normal inspection checking the fuel in the drop tanks. The fuel load was verified by the plane captain. Gross weight written on the aircraft read 21,000 pounds which agreed with my calculations.

"As I was strapping in the cockpit, the Air Boss passed the word that my aircraft would be launched 10 minutes early. I then started the aircraft and went through my normal post start and pre-takeoff checks. The aircraft was up.

"I had been spotted on the port catapult for start and after finishing my checks and giving a thumbs up to the director I was taxied into the launch position. There was a delay of a minute or so before I was tensioned up and given the full power signal. When I went to full power I checked all my instruments and they indicated normal—engine rpm 99.5 percent and 630° tailpipe temperature.

"I turned on my lights to signify that I was ready. As I saw the Cat Officer's green wand touch the deck I shifted my scan to the gyro. The *shot felt normal* as I went down the track and after bridle release I rotated 10 degrees nose up. My usual procedure is to rotate using the attitude gyro, crosscheck the angle of attack, then adjust the nose position if the angle of attack is below optimum. Also, I try to raise the landing gear immediately. (*Contrary to NATOPS but good head aboard ship.—Ed.*)

"As I rotated, there was an immediate shudder and the angle of attack indicated 3-4 units over optimum. I immediately reestablished my attitude to the optimum, or a unit above, and kept it there. During this time the gear was coming up. A few seconds later my scan picked up the altimeter. Not until then did I realize how low I was. The altimeter read ZERO or a little below.

"I immediately reached for the emergency jetti-

CASE TWO

"I was number two man in a flight of four A-4C aircraft scheduled for a 1215 takeoff and a 1245 Charlie at the ship. We were to make two day traps in preparation for night carquals. I thoroughly preflighted my aircraft, paying particular attention to the catapult and arresting hooks, and noted no discrepancies.

"When we checked in with the carrier we were informed that our Charlie time was set back 18 minutes so we climbed to 23,000 feet to conserve fuel. At 1255 we commenced a letdown to the ship. The break and pattern were normal; however, my first pass resulted in a waveoff. The second approach resulted in a trap and the following catapult shot was normal. My third pass was a little long in the groove with a slight climb at the ramp, catching number four wire.

"I came out of the gear with no problem and was taxied up to the number two catapult. After having a tiller bar inserted into the nose gear I was steered onto the number two cat. I taxied up to the shuttle and was given a hold. After about three to five seconds I was then given an off-the-brake signal but the tension signal was not given as men were still under the aircraft. I dropped my feet to the deck with

Bridle shed—shuttle collapsed nose gear

son handle and pulled it. At that moment, or a fraction thereafter, I hit the water. I was not aware that the stores had jettisoned, due to the impact on the water. I pulled the T-handle again as my plane slapped the water a second time. After the second skip the aircraft climbed rapidly.

"I began checking my instruments, noting my fuel quantity as 4000 pounds. To satisfy myself that the stores had been blown, I turned my lights on bright and steady. Then I looked at my fuel gage and saw that it was reading 3600 pounds. Realizing that I was losing fuel rapidly, I declared an emergency.

"I made an orbit of the ship at 6000 feet and then a long downwind, during which I let down to 2500 feet under radar control. I turned on to final and dropped gear and flaps at 7 miles. They functioned normally. Then I made several orbits while the deck was made ready.

"During this time the fuel gage dropped rapidly until it read 1500 pounds. Fuel loss slowed to what seemed to be normal usage and when my fuel weight reached 1000-1100 pounds the deck was ready and the barricade rigged. I commenced my approach and was arrested in the barricade."

If you're thinking this accident resulted from a cold cat shot, you're wrong. There was plenty of steam—*but the pilot forgot to lower his flaps.* He admitted not using the cockpit checklist, probably because of the tempo of operations and because the deck procedures normally insure a completed checklist. This time the tempo of operations was a little too hurried and the deck procedures didn't catch the error soon enough to suspend the catapult.

The old standard of so many A-4 series accidents was again recommended by the accident investigation board. "It is difficult to believe that after so many years of night all-weather carrier operations that the A-4 series still does not have a radar altimeter. Had the pilot had this rather *basic* instrument available he would very likely have observed a red warning light as he dropped below flight deck level, giving him an immediate indication of descent and enough warning to permit earlier jettisoning of external stores." ●

the power at idle. After about 15 seconds the tension and off-the-brake signal was given. I ran the power up to 100 percent, feeling the aircraft jerk as the bridle and Van Zelm took tension.

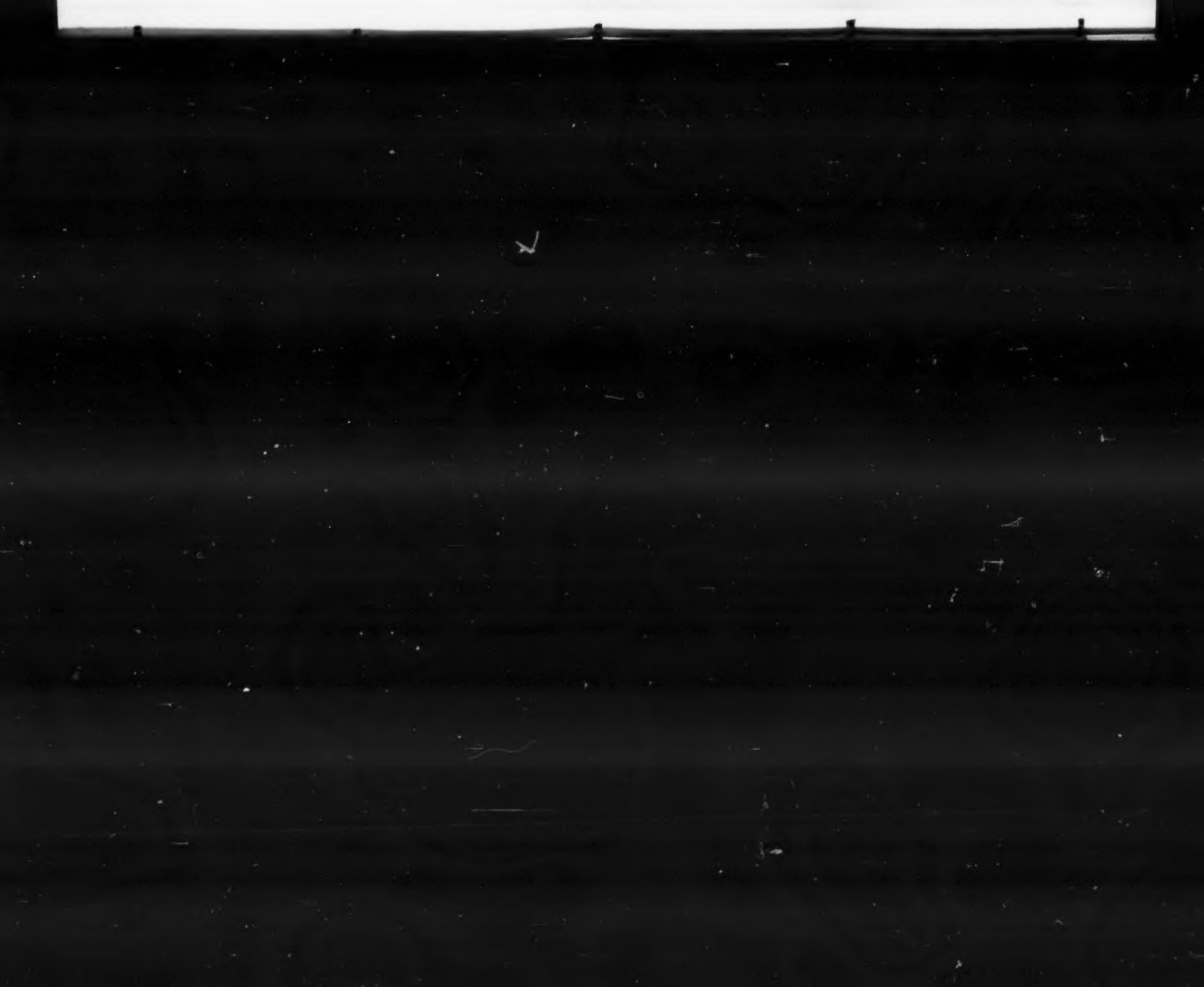
"The instruments were normal, the takeoff checklist was completed and the flight controls were free. The aircraft appeared to me to be ready for a catapult shot. I placed my head back, saluted the catapult officer, and got on the gages, in preparation for the night catapult shot.

"Through my peripheral vision I saw the catapult officer touch the deck. After about two or four seconds I felt a jerk and very shortly thereafter felt the nose of the aircraft hit the deck. I immediately looked up and noticed that the aircraft was moving slowly forward with the probe and nose cone on the deck. Not knowing whether the catapult had fired or not, I kept on 100 percent power.

"I also applied both brakes, locking the right brake. This caused the aircraft to swerve to the right toward the center of the flight deck. I figured that if the catapult hadn't fired yet, the locked brake wouldn't affect the end speed. After sliding about 30 feet, I knew the catapult had already fired. At this time I noticed the catapult officer running alongside the aircraft giving me the suspend signal. I pulled the throttle to idle and shut the aircraft down.

"The catapult officer gave me the open canopy signal and then assisted me in unstrapping and exiting from the aircraft. The fire fighting crew was standing by ready to fight any fire."

In the opinion of the board, the most probable cause of mispositioning the bridle on the catapult hook toe was retraction of the Van Zelm bridle arrester subsequent to catapult tensioning. As the catapult fired, the bridle was pulled from the catapult hook by the forward motion of the shuttle. The shuttle then continued forward, striking the nose gear and breaking the nose landing gear attaching bolt and tension bar. ●



OPS NOTES

EXCERPTS FROM SOME OF THE NAVY'S SAFETY COUNCILS THROUGHOUT THE WORLD, WHO PROVIDE LOCAL LEADERSHIP AND EMPHASIS TO THE NAVAL AVIATION SAFETY PROGRAM.

NOTAM Improvement

A serious look is needed to see if NOTAMs appended to the end of the weather reports cannot be spelled out in more understandable language. This is typical of a situation which has developed in aviation where sight is lost of the fact that the aids are supposed to help the pilot. Instead, the focus has turned so that the teletype circuit gets the aid and it becomes more difficult for the pilot. The important NOTAMs need to be spelled out.—*Aviation Safety Council, Brunswick, Me.*

Tower Talk

The use of the word "expedite" by tower personnel was questioned, particularly in regard to clearing the runway following landing. It was emphasized by the NAS representative that transmissions of this nature were purely advisory. However, it was appreciated that unwarranted use of this word might cause a less experienced pilot to react to the indicated urgency in such a manner as to jeopardize the safe operation of his own aircraft.—*Fixed Wing Committee, NAS Quonset Pt.*

European NOTAMs

The distribution of temporary base NOTAMs in the European area has been found to leave much to be desired. It is virtually impossible to determine airfield and runway conditions from this source. Combined with poor weather conditions, and planes of relatively limited endurance such as the TC-45J, this is considered to be an area of accident potential.—*Northern ELM*

Night Adaptation

At reveille, white lights are being turned on in passageways traveled by night adapted pilots enroute to flight deck for predawn launches. Action: air officer will request navigator to have word passed over 1 MC at reveille that "Darken Ship" is in effect and white lights are not to be turned on until "Lighten Ship" is announced.—USS INDEPENDENCE

Pilot Emergency Procedures

It was noted that pilots are occasionally reporting emergencies peculiar to their type aircraft with no explanation of the nature or seriousness of the emergency. Tower operators cannot be expected to assess the seriousness of a "utility failure" or "A.C. generator failure" when the pilot fails to indicate the seriousness of the situation and to broadcast his intentions. Pilots are encouraged to give as much information as possible about the emergency and to state their intentions.

—*NAS South Weymouth*

LANCE STERLING

versus THE BIRD DOG

by LCDR J. J. Schneider

It was an easy matter to have our schedules officer LT Wolfel put me down for a Bermuda hop, "have to check out that new kid, Sterling, what's his name, on overwater navigation." Word got around like a bar of soap in a Navy shower and before long the manifest and the coffee jugs were both filled and we had the C-54 in the air.

Well sir, I settled down to an article in an old "*Playboy*" when this kid Sterling comes up and shouts, "turn three degrees port, sir." I whipped the old bird over in a 45 to the left, dropping the magazine in the process, and strained the trusty old tear shedders through the heart of my horn rims to spot the bogey. Sterling had kinda a blank look on his face and he blurted out, "wasn't traffic sir, that's our new heading to Bermuda." Tell you the truth, I had forgotten all about his getting a navigation check, and he kinda impressed me with his eagerness, so I kept the heading he wanted, 'cause all the while I was playing a "carome shot" using the "bird dog" off the tail and it seemed like 3 degrees port wasn't going to hurt us none. Wouldn't do no good to shake the young feller's confidence.

Once I knew what he was up to it didn't bother none so I got back to my story. Every 15 minutes or so the kid would come up and ask me to turn another 2 or 3 degrees port. I had her on autopilot so all I had to do was slip my left foot out of my loafers and twist her around using my big toe against the rudder knob.

About three hours out, I let go with a good old fashioned bellow to express my feelings, when this guy Sterling goes close to tears thinking I'm peeved at him. Wasn't him at all—but it sure gets my 'nanny' to wade into a good story, really get involved and then find the finish gone outta the magazine. Somebody had ripped out the center fold and a few other choice pages so that you couldn't tell it from the "*New Yorker*."

When Lance gave me a "one degree port," which is what I call cutting it pretty thin, I asked him, "what's our ETA, Sterling?" He had it all figured and came right back with, "0302 Zulu, sir." "How much is that in American money?" I kidded him. A little levity now and then is good for crew morale I figure. But he didn't get the joke, "that's 2202 Eastern Standard, sir."

According to my Timex that meant we were only 10 minutes out. I dimmed the cockpit lights but even then I couldn't see any sign of land.

"Sterling, let's see your charts" I hollered, "this is a navigation check ride not a liberty launch."

One look at his paper work was enough to tell me we were in trouble. "Where the hell are your celestial fixes, boy?" While Sterling was making some meaningless excuses I was cranking the bird-dog 'round and 'round in hopes of getting a solid signal. Damned dog kept pointing to a big thunderhead about 50 miles off our port beam. You'd think by now that they could put some kinda gadget on those things to filter out that stuff.

Well, the reason Sterling didn't have any celestial fixes was, he hadn't checked out a sextant and the one in the plane had a broken bubble. He said he was navigating by the "Altimetry method," like all the big overseas airlines do.

I throttled back and leaned her out real good while I listened to Lance explain the merits of "Altimetry

Navigation." It seems "Ralph Bellamy" come up with a theory about measuring your drift based on the difference between pressure altitude and absolute altitude. You'd subtract one from the other and using a formula you could determine how many feet difference equaled how many degrees of drift. Sterling argued the method has been used by the airlines for years and was accurate to within ½ a degree. I slowed him down when I screamed, "then where the hell is Bermuda?"

Sterling started mumbling about delta this and delta that, when my thoughts snapped back to another night when I was discussing navigation. I was with my girl friend Monica at her place. Now she went out with this navigator feller, "Pan Am Eddie" besides me and it seems he was not too bright but he was very conscientious. He would even study in Monica's place, even with Monica there. Fact is, that's what led to us falling out, Monica and me. I stopped by this particular night I was thinking about, and in kissing her hand in greeting I noticed this big plus sign from a ball point pen, on the back side of her hand. Monica always extended her left hand so the plus sign was on her left hand, no doubt about it. As the evening wore on I found more plus signs on Monica and minuses too. All her lefts were pluses, left foot, left knee, left ear and another left too delicate to mention. The same way all her rights were marked with minuses. Naturally, I overlooked a few things, we weren't engaged or anything, but I felt in this case asking for an explanation would not be out of order.

"Where the hell did you get all those pluses and minuses?" I asked her.

You fellers at the head of the class probably guessed it by now. She told me this "Pan Am Eddie" was studying navigation and he had the whole thing down cold except which way to turn the plane. So that's why he marked old Monica up so. He wasn't too dumb when you get right down to it. The pluses were on Monica's lefts so you were drifting left. Conversely with the minuses.

Sure enough Sterling's charts showed an increase in the difference between the altimeters, a "plus." We were drifting to the left, all the while he was giving me those port corrections.

Let me tell you I didn't have to start a square search once I figured out what Sterling did wrong. A heading of due South soon put us in shooting range of the bird-dog and I set her down at Kindley before the first S.A.R. plane could get in the air.

Megatons or

We have all heard of that now famous and almost extinct "Kahili" bird that flies in ever decreasing concentric circles until the inevitable occurs.

Ornithologists have tried to explain this peculiar behavior that inevitably results in such an unpleasant *finis* by saying that he can't help himself; one wing is shorter than the other, they say, or his tail feathers develop reverse dihedral as he ages. In an attempt to find the real reason, we interviewed some other birds. There can be no doubt, as the other birds explained it, it's just a darn fool trick and if the "circle" bird were properly briefed before the hop, it would never happen.

Of course, we humans are too smart to pull a trick like that, or so we say. But on the other hand, are we? Some of our actions argue that we are not.

Here we are with weapons so powerful that "putting them down the stack" is no longer necessary. As a matter of fact, we can get a bull's-eye even by dropping in the next county. Such a potential for inflicting death and destruction the world has never before seen. Almost everyone knows that a five megaton bomb will kill with blast up to "X" miles, with heat to "Y" miles and radiation to "Z" miles. We are taught to keep in mind these important figures but let us pray that we'll never have to do more than think about them. Nonetheless, we have done an outstanding job of educating ourselves to the dangers inherent in these weapons. So much so that we have become in some cases, preoccupied with the nuclear to the extent that we may perhaps underrate the destructive power of the relatively small conventional weapon. In this respect, we are a little like our feathered friend. These small, inconsequential "iron bombs" are in fact killing and injuring our personnel and destroying our aircraft and other property. This has occurred all too frequently because we haven't taken time to brief properly or because we brief with inaccurate information.

A well remembered and much deplored "Kahili" bird incident of a few years ago cost the U. S. Navy an A-3 and an A-4 on the same flight. The incident took place during a fire power demo alongside an aircraft carrier. The evolution was a Pathfinder demonstration and among the reasons for the flight was the desire to impress VIP observers with the techniques and skills employed by the practitioners of naval air.

Let me tell you, they were impressed all right. As TV's Ed Sullivan might say, this was to be "The Reely Big Shew." However, the investigation revealed that the flight wasn't really planned to end in the manner that it did, but, had it been, the flight leader couldn't have done a better job.

Here in brief is what the investigation revealed.

The lead plane, the pathfinder, was piloted by a young man who knew nuclear weaponry cold. He knew the atomic yield, the blast patterns, the heat and radiation, in short, all the dimensions of nuclear weaponry. However, and here is the hooker, he had never dealt with live, conventional ordnance. In fact, he had *never* dropped live ordnance. Being a conscientious person, he asked the squadron ordnance officer to brief him on blast and fragment patterns of

Microtons?

By LCDR W. E. Coniff, Jr.
Ass't ASO, ComNavAirLant

conventional bombs. He was provided with this classic example of "Bum Dope." "Oh, you know the old rule of thumb—one foot for each pound of bomb." Thus equipped with up-to-date information, the lead character in our passion play proceeded on his way. The flight passed close aboard the ship in tight formation at approximately 500 feet altitude which—according to the good ol' thumb rule—was obviously a safe altitude. As the flight passed about 1000 feet abeam the ship, catastrophe struck! The Commanding Officer of the carrier has been quoted as saying, "I would have killed that squadron ordnance officer if I could have caught him."

Luckily, there was no damage to the ship and no fatalities. Losses were limited to the Pathfinder A-3 and the A-4 in the flight. Minor damage was suffered by an F-3 parked on the flight deck. The shipboard observers were not the only ones to be scared by the fireworks. The folks in the formation thought that "those b.....'s on the ship were shooting back!"

While this was a most spectacular "Kahili" bird incident, there have been others perhaps less spectacular but even more damaging. An accident involving the loss of a highly experienced pilot and aircraft is currently under investigation. The pilot apparently underestimated the wallop of "microtons." There have been frequent incidents wherein our personnel have been hurt or killed by practice bombs, 20MM HEI (high explosive incendaries), or with other kinds of conventional weapons. Aircraft have been damaged or destroyed with rocket and bomb fragments and blast. They have all been caused by monumental ignorance and were, without exception, avoidable.

Certainly there should be no misunderstanding about the responsibility of each individual involved in weapons employment. The pilot must be responsible for the safety of his aircraft, his crew and himself. The ordnance officer is responsible for providing the pilot with the weapons and the current information for their safe employment, and he must ensure that the handling crews are taking all necessary precautions. Above all, the Commanding Officer is responsible to see that they all do their job correctly. When this chain of responsibility breaks down, tragedy results.

The Ordnance Officer's task of providing the needed information is made easy for him by the issuance of publication such as: The "*Naval Weapons Bulletin*" (an article in the July/September 1963 issue of this publication contains an excellent article entitled "Safety Considerations in Aircraft Weapons Delivery"), Naval Warfare Information Publications (NWIP 20-1 and 41-3) and U. S. Navy Safety Regulations. There are handbooks, instruction manuals and pamphlets. No pilot should ever be allowed to climb into a loaded aircraft until he has been thoroughly educated in the weapons that he carries.

It is essential, of course, that we understand nuclear warfare and the employment of the weapons that may be used in a general war. However, for one to be preoccupied with the awesome potentialities of a megaton explosion while killing one's self or one's friends with a microton explosion doesn't make much sense—except to a "Kahili" bird.

Are you up on your 'Dead Man's Curve?'

Where was he when the engine quit?

By LT D.E. Beck

"Dead man's curve" is a badly abused and misleading term, but it has a profound impact on the minds of most helicopter pilots.

Actually, the term "Minimum Safe Height—Velocity Diagram" is the more correct title, but it fails to arouse the same interest as the more colorful Dead Man's Curve. In the last few years, some progress has been made in trying to educate helo pilots on how to interpret and intelligently use the height-velocity (H-V) diagrams shown in the pilots' flight manuals. But unless the pilots are able to understand and utilize it, the H-V curve is a wasted page.

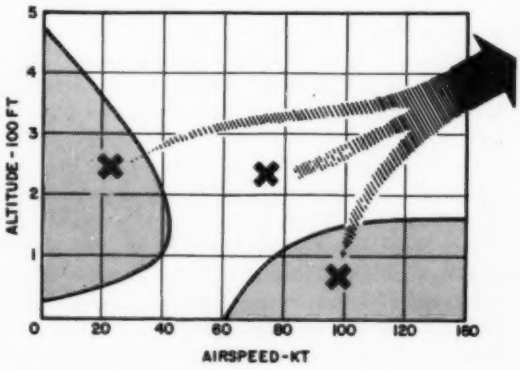
Many pilots deliberately penetrate the danger areas of the H-V diagram because they think they have proven it wrong. Nothing could be further from the truth. They are only fooling themselves, and are possibly leading others down the AAR trail. The dashing pilot who seeks new thrills in proving the manual wrong hasn't learned the rules of the game.

On the other side of the fence, we have pilots who think the H-V (or dead man's curve) is the absolute bible; and that deviation into the red areas can only result in total disaster in case of engine failure. This same pilot also thinks he is 100% safe if the engine quits while he is in the green area. Due to his lack of knowledge he may compromise the aircraft's ability to perform a given mission.

Let's examine in detail exactly what the H-V diagram represents, the ground rules used in its construction, and how you can intelligently interpret and utilize the H-V curve in the interest of safety.

The H-V diagram is a direct result of the contractor's aerodynamic and structural demonstration tests performed at the Naval Air Test Center, Patuxent River, Md. The contractor must demonstrate single (or dual as appropriate) engine failures and subsequent full autorotative landings from various entry conditions. The number of required demonstration points will vary from helicopter to helicopter; but in general, the contractor must demonstrate auto entries from the maximum rearward speed to the maximum forward speed. The landings must be accomplished at 15 knots or less ground speed under near zero wind conditions. Maximum sink rates of 6.4 to 8.0 feet per second at touchdown must also be demonstrated on certain landings to establish the structural integrity of the landing gear.

Knowing the required points to be performed in the demonstrations at Patuxent, the contractor's pilots begin a gradual but very extensive build-up program. The factory pilot performing the demonstration is



generally an old hand with plenty of experience. He knows his aircraft like the palm of his hand, and has been in the program since the helo went on the drawing boards. The aircraft is thoroughly instrumented to record such important parameters as control positions, sink rates, rotor RPM at touchdown, G-loads on the landing gear at touchdown, and blade tip to fuselage clearance.

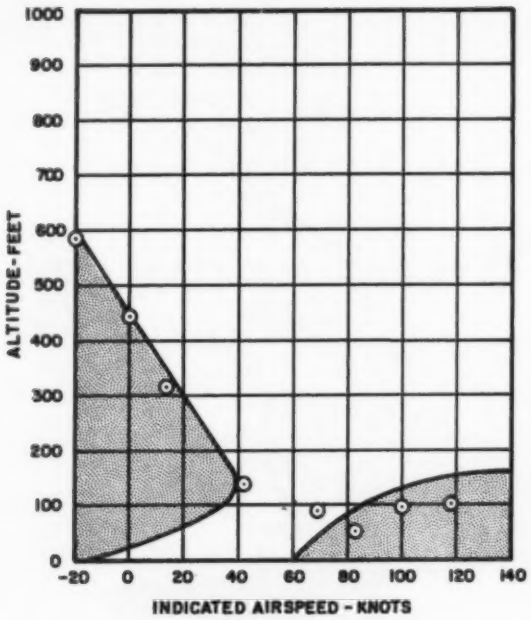
In some instances, the aircraft is structurally beefed up just for the demonstrations. In addition to the special instrumentation, the demo pilot has the advantage of the data and results of the previous build-up flight prior to undertaking a more critical demo point. Full photographic coverage of all landings is generally available to help optimize landing techniques. The contractor pilot may take 15-20 practice runs prior to optimizing and finalizing a demo point.

Having completed his build-up for the demo, the contractor pilot heads for Patuxent River, but not without his trusty maintenance crew. All demonstrations at Pax are contractor supported. The oleos, blade dampers, and key aircraft parts pertinent to each test are rigorously checked and rechecked. The ultimate goal, that of defining the H-V diagram and fulfilling the demo requirements, is ready to commence.

Only a few key points are demonstrated in the tests. This fact may surprise the fleet pilot, but full autorotational landings from critical entry conditions is a tough business. Contractor pilots will generally demonstrate only the points required by specifications, despite the added incentive pay normally associated with demonstrations. However, past experience on aircraft damage during aerodynamic and structural demonstrations often reinforces this point of view.

Let us look at the full autorotative landings from various entry conditions demonstrated at Patuxent for a current single engine fleet aircraft. The name of the aircraft is omitted deliberately. This article is merely to show how an H-V diagram is determined.

The actual demo points performed at Patuxent River are plotted on the original H-V curve. Given these points, the project pilots and engineers of the Rotary Wing Branch, Flight Test Division, Pax River undertake the assignment of defining a complete H-V diagram from the limited number of points. Rotor RPM at touchdown and landing sink speed at the various points may dictate that certain points be



weighed more heavily in the final decision. Other considerations are:

a. The degree of test experience and the amount of build-up the contractor demo pilot has attained.

b. The contractor's *planned* engine cut and planned delay time of 1 second (hence, he does not experience unexpected left yaw associated with engine failure in single rotor aircraft with tail rotor).

c. All landings are performed on a "straight in" approach into the wind on a smooth runway.

d. All entries are made in level flight.

e. Extensive special instrumentation information available to the contractor pilot.

f. Contractor pilot's exact knowledge of his gross weight, c.g., and the ambient conditions at all times. Needless to say, an artist's license in fairing curves and *good common sense* dictate the final diagram shown in your manual. However, Patuxent River is not the final judge on the H-V curves. The proposed Pax H-V curves are submitted to BuWeps for revision or final approval, the boundary lines of H-V curves are changed and caution areas added at later dates when more test data is available. What the fleet pilot sees in his NATOPS Flight Manual is the best estimate considering the data available. You may prefer to call it a "guesstimate," as the final outcome is no more than a good guide. All H-V curves are based on the following:

- A specific gross weight
- A specific rotor RPM at entry—normally max continuous operating RPM in recip engines or 100% rpm in turbine engines.
- A particular density altitude.
- A delay period in lowering the collective after the engine cut (normally one second)
- A one G unaccelerated, level flight entry condition.

Knowledge of the above conditions is mandatory. You can't play in the game unless you understand the basic rules. The fact that H-V diagrams are based on level flight entries and a one second delay period are factors that are often overlooked. The one second delay period is not an overly conservative figure for an unexpected engine failure in recip powered helos. Two seconds is a more realistic delay period for turbine powered machines due to the very slight change in the noise level at engine failure. Turbine engine failures are subtle and future curves will soon be based on two seconds for this very reason.

Some of the present fleet flight manuals show a few of the assumptions used in constructing the curve. The present SH-3A NATOPS Flight Manual defines the gross weight, pressure altitude, and OAT conditions. Not too many years ago, the H-V (or dead man's curve) was just an unexplained diagram, as in the SH-34G manual. Some pilots ignored it, others were scared of it, some considered it as gospel, and others didn't care about it as they had their own theory of full auto landings. How many times have you attended a comprehensive safety lecture on the H-V diagram? The odds are 10-to-1 you haven't. Why? The answer is easy—the word hasn't been passed along to the squadrons.

Now that we understand the basis of how the H-V diagrams are constructed, let us proceed to see how we can utilize the diagram in the interest of safety and hence possibly extend our life span. We know the H-V diagram is based on one G level flight entry conditions.

What about the poor guy who loses an engine at heavy weight in a full power, climbing turn on a hot day? He may be in the green area of the one G curve, but this *does* not guarantee a safe landing. Rotor RPM decay rate would be extremely rapid in this flight regime. The pilot may not be able to afford a one second delay before encountering retreating blade stall under these conditions. Even if he does

not encounter blade stall, the distance to the terra firma may not be sufficient to allow a build-up of adequate rotor RPM to execute a safe landing. We all have seen pictures of piles of rubble that result from hard autorotative landings at low rotor RPM. Hence for the climbing aircraft at high power the H-V diagram is somewhat falsely optimistic and a bit pessimistic for the descending helo.

When the situation dictates, the Army and Marines often cruise at the tree-top level, near V_{max} in low level assault missions. Here again, the one second delay on the collective may be intolerable. This autorotation entry must be initiated immediately, using a judicious combination of down collective and aft cyclic, depending on the particular helicopter. One should always hit those big pine trees as slow and at as low a sink rate as possible. In any case, the pilot who flies this mission is generally in the lower right-hand corner of the H-V diagram where the color is red. His reaction time must be very rapid in order to prevent a major disaster.

Many old ASW pilots have cranked the turns (engine RPM) back to 2200 in the SH-34G/J when they were sweating out home plate, and their ever decreasing fuel state. This is a good time to cruise at higher than the normally prescribed 200-500 feet, if possible, and hence allow for a longer period to transition to autorotation and regain the rotor RPM in case of engine failure. Most H-V diagrams are based on low density altitude conditions. The pilot who figures it is a no-sweat condition at 100 feet with 40 knots indicated airspeed at 8000 feet density altitude in the mountains is in for a rude awakening if the engine quits. Even the hottest of pilots may find this situation a bit too taxing for his ice water nerves.

Another factor to remember is that the contractor's demo points (the basis for the H-V diagram) are done into the wind. What about poor Joe Doaks who is 60 KIAS and 200 feet heading downwind with 30 knots of wind? You can have this sticky situation and decide the best solution yourself. We all talk of delay time. Yes—we all practice straight in, 90-degree and 180-degree autos, but how often do we delay one second during the entry? Don't we normally cheat and start the collective down as we hack the power off? Who can blame the poor UH-2A driver for hanging onto the collective for more than one second when the T-58 quits at 150 feet on a black, overwater night hop?

Up to now, all discussion has been centered on engine failure in a single engine aircraft or dual engine failure in a twin-engine aircraft. H-V diagrams for safe single engine landings in multi-engine choppers are made on the same basic ground rules and require the same diagram interpretation.

In conclusion, it must be stated that there is no magic solution or equation that enables one to always fly within the safe limits in order to more likely ensure a safe landing in case of engine failure. We at NATC are constantly striving to make the demonstration tests more inclusive and hence give the fleet a better H-V diagram. However, it is a good safety practice to learn the basic H-V diagram in the flight manual and know the basic considerations in making the graph. Be especially aware when you are flying in a more critical flight regime—such as, heavier gross weight, higher density altitude, lower rotor RPM, climbing flight or banked flight.

Try to tailor your normal flying to stay within safe limits and allow for a cushion when your condition becomes more critical. When the mission dictates that you penetrate the real danger areas for engine failure—Be Alert. Your reaction time may be slower than you think.

LT Don Bock is a graduate of the U. S. Naval Test Pilot School and is presently attached to the Rotary Wing Branch of Flight Test at NATC. He was the Navy test Pilot on the joint Army-Navy Military Research Evaluation of the Lockheed XH-51A rigid rotor helicopter and has been assigned to the CH-53A program. LT Bock completed a 4 year tour in HS-6 prior to reporting to NATC.

Bad Gyro

Deployed in WestPac with the trustworthy A-1H, I decided, while on a quiet afternoon strikex, that my wingman and I could stand a little cloud flying. We found some light CUs about 100 miles from the ship and as we were in the middle of the Pacific, I led into them while on a VFR clearance.

Prior to cloud entry all instruments in my aircraft were reading normal except for the RMI, which was inoperative. After several minutes of "Actual," we hit a couple of good bumps and I looked back to see how my wingman was doing. He was OK. Upon looking again a few seconds later, he was gone.

I asked where he was and he replied that he'd "lost sight." I eased in back stick to climb slightly and called, "OK, level off and head 090 degrees. I'm climbing and turning right to 180 degrees. This is a small cloud and we should be out in a couple of minutes, then we'll rendezvous." While making this transmission, things turned to worms for me. I recall thinking to myself, "Keep your voice calm."

Having eased in back stick, I looked at my gyro horizon and saw I was in a 30-degree to 60-degree starboard bank, nose down. My scan, which up until now had been good, ceased and I stared solely at the gyro horizon while pulling back and rolling in left stick. Nothing happened to the gyro, it stayed as before. Things didn't sound right and I noticed my needle ball two-blocked. I forgot the VGI and leveled my needle; in the meantime, A/S had built up.

Next, I got the rate of descent stabilized and things started to smooth out. This all took place in a matter of seconds, yet I can't emphasize how many thoughts crossed my mind while even still giving my wingman directions. "What's wrong with

ANYMOUSE

The purpose of Anymouse (anonymous) Reports is to help prevent or overcome dangerous situations. They are submitted by Naval and Marine Corps aviation personnel who have had hazardous or unsafe aviation experiences. As the name indicates these reports need not be signed. Forms for writing Anymouse Reports and mailing envelopes are available in ready-rooms and line shacks. All reports are considered for appropriate action.

— REPORT AN INCIDENT, PREVENT AN ACCIDENT —

me? Can't I fly instruments? Should I bail out? No! What's wrong with this damned plane?"

And that thought brought forth the answer. The VGI had failed, but no failure flag appeared. It took me a second or two to realize and convince myself of this, for I've had quite a few hours in the *Spad* and can't ever recall the VGI failing in flight. Finally, after several nervous minutes, I broke out with wings level but with the VGI still showing a 60-degree bank and full black.

Once VFR and rendezvoused, I turned my attention to the VGI and seeing what kind of unusual attitude I could get in flying strictly by this instrument alone. Believe me, it was easy.

Flat On My Back

My crewman eyeballed the *Stoof*, everything looked all green-go. I gave her the once over and we climbed aboard for a four and a half hour trip home and a couple days off. Start and taxi were normal but upon spreading the wings, the hydraulic pressure wouldn't drop down off the 3000 lb. peg. "Pins are all home," says the ground crew. Should we ram that lock handle home and go? Not exactly NATOPS.

Back to the line and a short delay. A microswitch was repaired and, on our way back to the bird, we stopped by the line shack to ask for an NC-5 – she's a *Stoof Three* (S-2D).

We walked down the middle of the ramp, about 75 feet wide, with jets turning up on each side. Can't hear a thing. Next – POW!! We were flat on our cans looking straight up into the big yellow eyes of an NC-5. Two fellows on the "5" said, "Sorry, sir, didn't see you, must a been in a daze."

We got up and proceeded to the dispensary for treatment of skinned knees, sore back, sore ribs, bruised shoulders, numerous contusions and abraisions. Thus this verse:

Don't down that airplane
You may make someone mad,
And if you do
Be on the lookout, Dad!
If you take the bird
You have fighting odds,
The downing gripe
Is 'tween you and the gods.
But if you down the bird
You may not stay alive.
They'll send someone after you
In an NC-5.
The moral of the story?
Get into the blue!
The guy they're after
May be you!

The Big Squeeze

The plane commander and copilot of an S-2D were rushing to make a 0315 launch off an Atlantic Fleet CVS. Their plane hadn't been spotted on the flight deck until 10 minutes after everyone else had manned aircraft so they were in a hurry to do likewise. The pilot preflighted the a/c while the copilot went through the pre-start check list. When the copilot came to "Torpedo Bay Doors" on the check list, he noticed that the switch was in the OPEN position. He assumed it was there incorrectly, and moved the switch to CLOSED, so that the switch and doors would be corresponding. The plane commander then entered the aircraft and external power was plugged in. An unusual sound was heard and both pilots immediately realized that the torpedo bay doors were trying to close.

A very shaken ordnanceman then emerged from the torpedo bay. He had been in the process of removing the torpedo bay door jury struts when power had been applied and the doors had tried to close on him. The jury struts were bent by the action of the doors, but they held and saved his life. Had he been just a little sooner in starting to remove the jury struts he would have been pinched in two by the doors.

Henceforth, in this squadron, pilots are going to be *certain* that the doors and switch are corresponding, and are going to refrain from taking short-cuts with the check list. Also, ordnancemen are going to avoid getting all the way inside the torpedo doors when possible, and will let the pilot know of their presence. Pilots are going to show *both hands out the overhead hatch* prior to an ordnanceman getting inside the torpedo bay.

HEADMOUSE

Lq Ox or LOX

Dear Headmouse:

Re: "Key to Lox" April issue. Is LOX the approved abbreviation for liquid oxygen, breathing?

CARL L. BROWN, AME2, VAP-61
FPO, SAN FRANCISCO

. . . Seems there was a letter publication several years ago changing the abbreviated designation of breathing oxygen, liquid, to LqOx. Please let us know if this pub is still in effect.

Why is the man in the cockpit while the aircraft is being serviced with liquid oxygen? The man handling the service unit is well protected from the danger of accidently spilled oxygen but what happens to the man in the cockpit if the hose were to rupture and spray him?

C. E. DRAKE, GYSGT, MAC-31
MCAS BEAUFORT, S. CAROLINA

. . . What's the proper abbreviation? . . . Some Safety Center posters show it as LqOx but April '64 APPROACH, U. S. Navy Safety Precautions OpNav 34-P1 and Enroute Supplements show the "proper" abbreviation as LOX.

V. S. TWEET, AEC
DALLAS, TEXAS

▶For several years there has been a general feeling of apprehension that the use of the abbreviation LOX for high purity liquid oxygen would lead to confusion resulting in the possible inadvertent substitution of the explosive product for high purity liquid oxygen in aircraft systems with disastrous results. Several sources have proposed that a more appropriate abbreviation for high purity liquid oxygen be standardized so that all possibility of confusion with the liquid oxygen explosive would be eliminated. The Naval Aviation Safety Center subscribed to this line of reasoning at that time and therefore adopted the abbreviation "LqOx."

The results of studies by various agencies tend to minimize this concern over the possibility of mistaken identification. The basis for this is that, first, that it is not commercially feasible to manufacture and distribute a self-contained industrial liquid oxygen explosive. Under these circumstances, it is difficult to conceive of the Navy, Air Force or any other agency receiving liquid oxygen explosive components inadvertently, much less mistakenly introducing them into an aircraft or missile system.

Use of the term LOX for high purity liquid oxygen in the Navy, Air Force and industry has become firmly entrenched terminology. Since the possibility of confusion of the two products does not exist for all practical purposes, and no useful purpose is served in attempting to eliminate the abbreviation LOX from military and industrial terminology, the term LOX, appears to be the accepted abbreviation for high purity liquid oxygen.

Authoritative references include the following manuals and publications: Mil-M20800 of May 1961 Military Specification for Manuals, Technical, Atomic (Nuclear) Weapons, which states: "Abbreviations shall be held to a practicable minimum consistent with clear presentation, and when used shall conform to the GPO Style Manual." The GPO Manual: "LOX (no periods), liquid oxygen." Besides the documents cited by Chief Tweet and those just mentioned are the USAF Dictionary, NavWeps 00-80T-96, Aircraft Support Equipment (General Handling and Safety Manual) and the Handbook of Inspection Requirements (HIR) for many of the late model aircraft having liquid oxygen systems.

Custom and usage now dictates that NASC amend its policy concerning liquid oxygen and adopt the abbreviation LOX.

As for the man in the cockpit during LOX servicing—you're right, GySgt Drake, he doesn't belong there for the reasons you state. But you know how it is, if a camera is around—someone always "MUGS" it.

Very resp'y,

Headmouse

Orange Seat Covers

Dear Headmouse:

New aircraft seem to be coming out with brightly colored international orange fabric seat covers. Is there anything in writing which requires replacement seat covers installed on the squadron level to be of such material?

Aircraft cost per hour is a problem sweated by most aviation units. The international orange fabric costs $4.70/yard while red leatherette is available for $1.74/yard. The leatherette is easier to clean, does not absorb grease and

dirt as readily and thus is less of a fire hazard.

While international orange colored seats are a real aid in locating aircraft wreckage, some squadrons may be reluctant to spend the extra money for it unless they are required to do so.

ASO, VP-31

▶ International orange seat covers are NOT a requirement.

Very resp'y,

Headmouse

Lighted Radar Rescue Buoy

Dear Headmouse:

There has been a continuing requirement in the Navy for a simple, inexpensive and versatile Rescue Buoy which could provide the following capabilities:

- Have the drift characteristics of a man in the water.
- Have sufficient buoyancy to support a man.
- Be capable of dispensing dye marker and turning on lights on contact with water.
- Provide adequate radar reflection for S band radar.
- Be easy and inexpensive to manufacture by ship's force.

Based on the above criteria, TICONDEROGA built a lighted radar rescue buoy utilizing a 35 gallon drum used to ship electronic subassemblies. Two white lights (12 volt), salt water battery actuated, were mounted on the top of the drum. The dye marker used was of the standard sonobuoy type, and was released on impact by a simple plunger arrangement.

TICONDEROGA with USS COWELL (DD-547) and USS PRITCHETT (DD-561) in company evaluated the subject buoy. The following data is pertinent:

Weather Clear, visibility unlimited, seastate 2.

2345T Buoy dropped from its rack under the flight deck round-down Lights came on within 60 seconds. Ships proceeded directly away from buoy.

4000 yards Both destroyers lost radar contact.

7000 yards USS COWELL lost visual contact.

12,000 yards USS PRITCHETT lost visual contact.

18,000 yards No visual or radar contact. Ships reversed course, formed line abreast and commenced search for buoy ahead.

11,000 yards Buoy reappeared on all surface search scopes and painted solid and continuous.

10,000 yards Buoy sighted visually from TICONDEROGA *bridge*.

7000 yards Buoy sighted visually from both destroyers' bridges.

Destroyers had no difficulty tracking into alongside the buoy. Buoy was recovered by PRITCHETT and placed in G.I. can full of salt water. Lights burned continuously for eight hours.

The inherent value of this type of buoy is self-evident. A more sophisticated model is now being manufactured which will have a precisely cut radar reflector to give increased range. It is also planned to equip it with a "pinger" to provide sonar homing. However, in either the simple or sophisticated version, the lighted radar rescue buoy is the least expensive device available to provide a point of reference for a SAR mission, and is a readily identifiable object for the man in the water to swim toward, having full assurance that his ship will have no difficulty locating the buoy.

CO, USS TICONDEROGA (CVA-14)

▶ This is one of the best of the buoy designs we have seen so far. (Drawings included in NASC (Personal/Survival Equipment Crossfeed 3-64.) We would recommend that local manufacture of the buoys be continued; the cost of having them manufactured and put in stock would be tremendous. Our only suggestion to improve your design would be to paint it with epoxy or plastic-base paint and cover the top with no. 3484 red and no. 3270 silver pressure sensitive reflective tape.

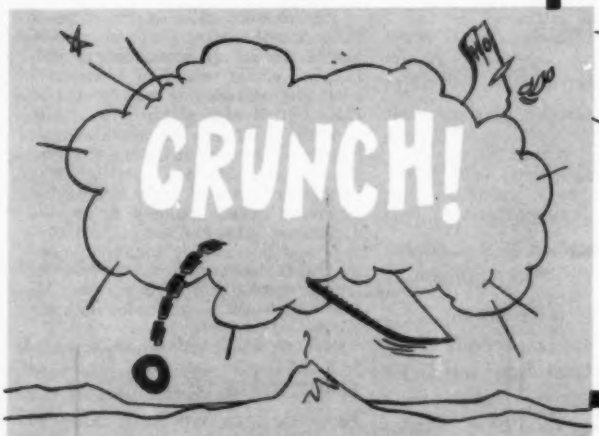
Very resp'y,

Headmouse

"How come our planes always hit prize hybrid grain and never the inexpensive kind?"

HO-HU

BOARD REPORT: PILOT FACTOR.
CONTRIBUTING FACTOR: INATTENTION
REVIEWING AUTHORITY: *CONCUR!*



HO-HUM—What a day for a section nav hop. Warm—nice—The mountains sure look pretty in the distance—Glad I am wing on this leg so I can do a little sightseeing—Wonder if I can spot any new volcanoes—Hey! don't—move out—CRUNCH-

HO-HUM—Just listen to that engine purr—That ol' sun sure fe Love these low-altitude sandblower hops—The sea looks so pretty the closer you get—Might as wel ha —First landmark in 10 minutes—Hey, what's with be that lo—SPLASH!

—Contributed by

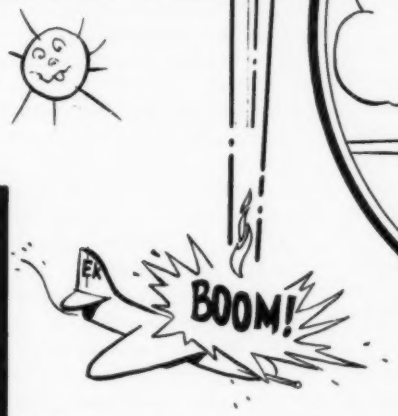
HO-HUM—Wonderful day for touch-and-go's—clear smooth air—Guess I'll have to stay down after this one—Wonder what these people are doing over on the right—Guess they are going to town—Beautiful kimonas—Hey, was that a flare? Must be something wrong—I am OK though and touching down—SCRUNCH!

UM

ON

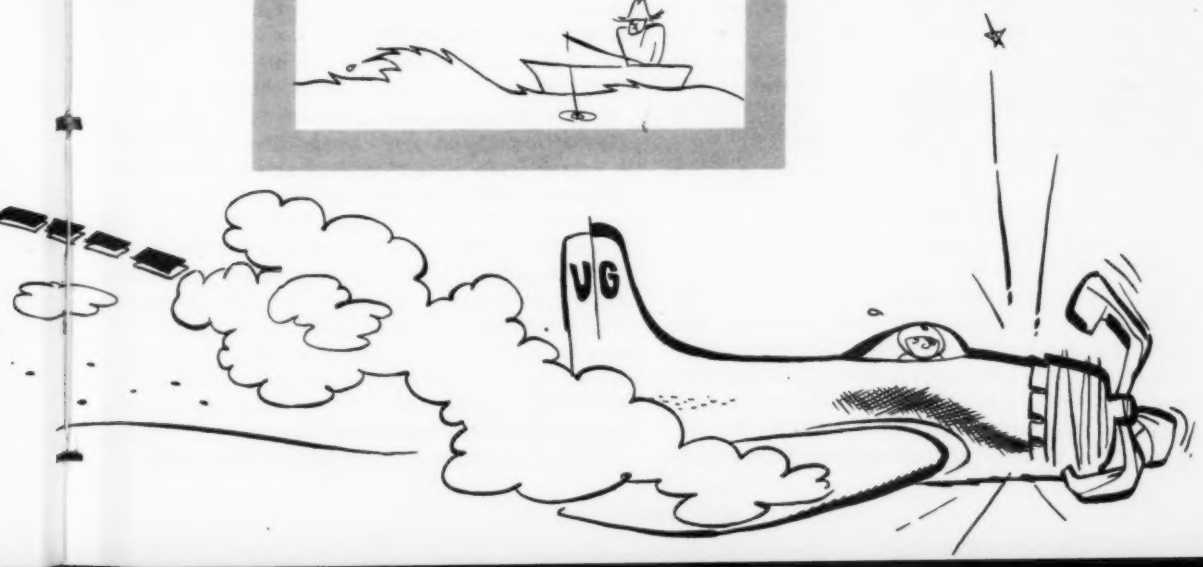
' sun sure feels warm on my back—
ps—The sea is sure sparkling and
ht as well have a cigarette and relax
what's with the altimeter? I *can't*

Contributed by 1stMAWing



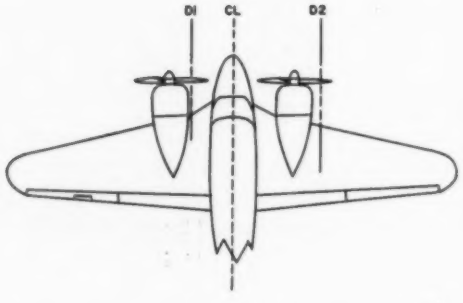
HO-HUM—So warm and pleasant up here —Guess I'll call in and extend my time so I can run down the coast—Look at that surf—I'll drop down for a closer look—All those people fishing—Guess I ought to be getting back—Darn! I can't have used that much fuel. Where's the charts? Can't find a field—Fuel gone—Got to get out! BOOM!

HO-HUM—Boy it sure is nice out today. Look at the warm sun sparkle on the cloud tops down below—Never saw the sky so blue except the time Mary and I—. Guess I ought to check my position in a minute or two—seems like I just did —Huh! It's been 20 minutes? Where the heck am I? Can't get a bearing—? Mayday! Mayday!



The following article by Mr. T. F. Heffner, which recently appeared in BUSINESS/COMMERCIAL AVIATION, has been reprinted by some airlines. Though written primarily for pilot's transitioning to light or medium twin engine aircraft it may add to your understanding of Vmc.

Vmc in Engine-out Operations



The forward pull of D_1 (descending blade of No. 1 engine) is the same as D_2 (descending blade of No. 2 engine); however, the center pull of D_1 is much closer to CL (the centerline of the aircraft) than D_2; therefore, the turning moment of D_2 is much greater than the turning moment of D1.

To fully understand Vmc, it is important to investigate what happens to control when an engine fails, and why it happens. In this situation, control of the aircraft comes first. The performance drop must be taken into account, but this is secondary to the pilot's maintaining control when forced to maneuver with one or more engines inoperative. He must be able to maintain Vmc or above at this point, or else the airplane with one engine out will become unmanageable.

The most immediate and direct result of a sudden loss of power in one engine is a yaw toward the failing engine, caused by a suddenly unequal power between the two engines and a sudden increase in drag from the wind-milling propeller. The magnitude of this yaw will be determined by the particular engine-prop combination (greater yaw for higher power), the angle of attack of the aircraft (greater yaw for higher angle) and the length of the thrust and drag arms. (The thrust and drag arms are the distances from the approximate centerline of each engine to the centerline of the aircraft, that on the side of the dead engine being the drag arm and the other the thrust arm. The greater this distance the higher magnitude the yaw will be.)

The contributions of thrust and drag to yaw are obvious, but the effect of the angle of attack is more obscure. Angle of attack produces a reaction from the propeller that for many years has erroneously been considered entirely due to torque. Torque in the pure sense of the word would be a force created by the actual revolution of the engine, but in fact it is caused by an imbalance in thrust between the blades of a propeller that is operating at an angle to the relative wind. This effect is known as the P factor, and is due, briefly, to the fact that the blades of a prop are constructed like small wings and create lift (in this case, thrust). Because these wing-like blades are rotating around a common axis, any angle between the line of this rotation and the relative wind will create a different effective angle of attack for the downgoing blade than for the upcoming blade. As with wings, the blade with the higher angle of attack will produce more lift, or thrust.

Since U.S. engines rotate to the right, the propeller is rotating in a clockwise direction. When the aircraft has a positive angle of attack, the downgoing blade has a higher angle of attack than the upcoming blade and consequently produces more thrust. This inequality of thrust is responsible for a yaw force to the left in a climb, since the right side of the propeller circle is thrusting forward faster than the left side. If the airplane has a negative angle of attack the situation is reversed and the yaw force will be to the right. This phenomenon is the major reason for holding right rudder in a climb and left rudder in a dive.

Although yaw toward the failing engine will be

the most immediate result of an engine out situation, there are accompanying motions further complicating the control problem. Picture yourself in a typical engine loss situation. If your left engine fails, there will be an immediate yaw to the left due to unbalanced power and drag. This yaw will be quickly followed by a roll to the left caused by the loss of slipstream-induced lift on the left wing. With the airplane banked toward the dead engine, it will simultaneously skid toward the live engine, further increasing the angle of left bank.

All this happens quickly after the engine dies, and immediate action is required to bring the airplane back to a stable condition. In order to pick up the dead engine wing, you need positive aileron deflection. In most airplanes, however, this action will produce more yaw due to the drag on the down aileron, further deteriorating the control situation. The first problem confronting the pilot, therefore, is overcoming the yaw, accomplished in this case by right rudder. In the same process, the skidding motion will be arrested, and then he will be able to safely reduce angle of bank with aileron deflection. In the actual situation, both these remedial actions will be done almost simultaneously and he merely has to lead somewhat with the rudder.

If an engine fails when the effective angle of attack of an airplane is higher than normal and the airspeed is relatively low (such as a climb out or a power approach), premature aileron deflection can create another hazard. Under these conditions the rate of yaw and roll can quickly reach a maximum if an engine fails. A sudden aileron deflection plus the high rate of roll (both of which act to increase the effective angle of attack) may result in a tip stall on the dead engine side all at an altitude that gives little room for recovery. This is a spot where it is essential to correct for yaw with rudder action before using aileron deflection to bring the wings back to level.

The power available from the rudder to arrest yaw after an engine failure is, for practical purposes, independent of airspeed. On the other hand, the power of asymmetric thrust to produce yaw varies considerably with airspeed. This is due mainly to the fact that rudder effectiveness and directional stability both vary at the same rate as the airspeed, while asymmetric thrust varies inversely. In other words, asymmetric thrust increases in power as both airspeed and directional stability decrease, creating a particular point in airspeed for any given airplane below which it is no longer possible to regain and maintain control in steady flight. This critical point in airspeed, the speed that can make or break an engine out situation is Vmc.

Vmc Varies

Vmc is not a constant speed for a given airplane, but is subject to a number of variables. It is important for the pilot to understand these variables, for he will have to be aware of conditions that tend to raise and lower his minimum control speed.

In a conventional airplane all forces act around the center of gravity. Therefore, moving the CG aft shortens the arm through which rudder force acts, making rudder action less effective and thereby raising the speed at which control will be lost. Certain natural conditions will tend to lower Vmc, giving the pilot greater latitude of control, and there are also certain things that the pilot can consciously do to increase his margin of control.

Higher altitudes (at which maximum power is not available from the live engine) will reduce the thrust force, thus reducing yaw, and lower the minimum control speed. Depending upon individual design characteristics of a given aircraft there will be an altitude above which directional control will be available until the airplane actually stalls. But perhaps the most important contribution the pilot can make toward lowering Vmc is a quick identification of the failed engine and feathering the dead engine propeller. This cuts down on drag from a windmilling propeller and gives the pilot more time to regain stable flight.

To establish the minimum control speed that is contained in an individual airplane's flight manual or pilot's handbook, aircraft manufacturers test the airplane under the most adverse conditions of weight, center of gravity and configuration. The results of these tests are then reduced to sea level takeoff power conditions, producing a safe, conservative number that may be used as it is without adding any fudge factors.

The pilot of a multi-engine airplane who knows before takeoff the performance and Vmc of his airplane under all possible emergency conditions, who understands the various forces and motions that may result from an engine failure, and who is mentally prepared to react to the situation quickly and correctly, has all the odds going for him in the event of an emergency.

P.S. See also "The Importance of Vmc"—APPROACH December 1961, pg. 12.

BAILOUT SPLASH

On the fifth attempt to land aboard carrier, an A-3B hit the deck and boltered with damaged nose gear and loss of utility system hydraulic pressure. All three crewmembers successfully bailed out from 6000 feet, five miles ahead of the force. . . Here is the bombardier/navigator's story.

During the time we were orbiting, we went over bailout procedures. At the pilot's command, I pulled the lanyard actuating the escape chute blow-down system. The third crewman left first. After pulling my bailout bottle green apple, lowering my visor and disconnecting my oxygen hose and radio connections, I bailed out right after him.

Slipstream shock was a lot less severe than anticipated. When a slow, flat spin developed I spread my arms and legs and immediately stabilized.

The parachute deployed automatically. Opening shock didn't seem to be very hard. However, even though I had cinched both of my legs straps up tight in the cockpit, they slipped open a bit. This allowed seat pack and life raft to slide up high behind me. Working back into the seat and reaching the life raft fitting was impossible. Re-cinching my leg straps had no effect.

I raised my visor, disconnected one side of my oxygen mask and turned on both of my survival flashlights.

Although there was no moon, below I could

see the third crewman's parachute and his survival light. The abandoned aircraft was flying level in a slight port turn. Scattered clouds indicated I was down to about 2500 feet. Coming out in the clear I watched the third crewman enter the water.

Unable to get back into the seat or extract the life raft from the seat pack, I elected to abandon both on water entry rather than take a chance of fouling in shroudlines or life raft lanyard. Unbuckled the chest strap and took a good grip on the leg strap quick release snaps. About this time was beginning to swing back and forth. Up to now there had been very little apparent motion but pendulum movement increased closer to the water. There was more wind. Just after starting down from the top of a swing over the whitecaps, hit the water flat on my back, real hard.

Immediately released the leg snaps and raised my arms. The parachute dragged me only a short distance before the harness cleared, tearing off oxygen mask and the left sleeve pocket with pencils in it. Treading water I inflated my life vest.

The very rough seas made it difficult to keep head above water. With the wind to my back and by arching backwards, I was able to maintain a good buoyant position facing the carrier. Fired two tracers from my .38 caliber revolver and immediately one of the plane guard destroyer's searchlights swung over and stopped in my general area. Spaced tracers at short intervals firing 14 rounds. Reloading with one and two shells at a time wasn't difficult.

After 10 minutes in the water, my strobe light quit but the one-cell flashlight burned brightly throughout the entire proceedings. In between firing rounds of tracers, I blew my whistle several times to make sure it would work when rescue became more imminent.

Twenty minutes later, a destroyer passed to my right and I ignited a night distress signal. Shortly after the signal burned out, the destroyer was directly ahead, slowly bearing down on me. When a small light focused on me I asked if anybody saw me. Immediately I was centered in a large searchlight.

A swimmer from the ship took me in tow and with both of us swimming and the tow line being pulled in, we came alongside. With very little difficulty I grabbed the landing net and was quickly hoisted aboard. While being hoisted, it was all I could do to hang on. Considering the weight of water-soaked flight gear and boots, a sling to hoist downed aviators aboard ship is preferable to a net.

Another item — I highly recommend retention of the hard hat until rescue is completed. While in heavy seas alongside the destroyer I was pounded against the side of the ship. The hard hat kept my head from being bashed in!

Disconnect

AFTER a landing accident, an A4B pilot escaped from the inverted aircraft with some difficulty. After he crawled out of the cockpit he discovered he was still restrained by his oxygen-communications hose. Only after he was released by a member of the crash crew was he free.

The pilot's oxygen-communications hose plugs into the seat pan which in turn plugs into the console. Flight surgeon's recommendation: A-4 pilots should be briefed as to the necessity for disconnecting their oxygen-communications hose manually prior to leaving the cockpit. The pilot must disconnect hose from the console if he is taking the seat pan and from the seat pan if leaving it behind.

Dye Marker

THE pilots of aircraft orbiting the survivor in the raft reported that the initial release of dye marker and the trickle of dye trailing the raft were invaluable in maintaining visual contact.

—From an AAR

No Life Vest

IN HASTE to expedite rescue, a pilot being picked up by helicopter forgot survival common sense and jumped into the water from a fishing boat *without his life vest*. He had discarded the vest when picked up from his raft by the boat crew. Safely aboard, he removed his life vest. The ASW helo tried to pick him up from the boat but was unsuccessful. The rescuee, after being signaled by the helo pilot, jumped back into the water, *minus life vest*. The helo fortunately made a successful pickup.

Fatal Distraction

A PILOT took off on a night IFR flight plan as lead in a two-plane flight. Two minutes after takeoff, the aircraft had reached an altitude of approximately 1500 feet and an airspeed of approximately 310 knots. At this point the wingman saw the aircraft enter a right descending turn. It crashed in a tidal mud flat.

Investigators were of the opinion that the most probable cause of the accident was pilot distraction while shifting frequency. The second most probable cause was pilot disorientation/vertigo induced by head movements while shifting frequency.

Shared O_2 Mask

THE pilot of a DB-26J took off without his oxygen mask on a night VFR flight at 9000 feet. He had looked for his mask before takeoff, could not find it, and left without it.

On one leg of the flight the lowest available altitude was 13,000 feet. During this leg the pilot shared the oxygen mask of the adjacent observer passenger or sucked oxygen from the hose.

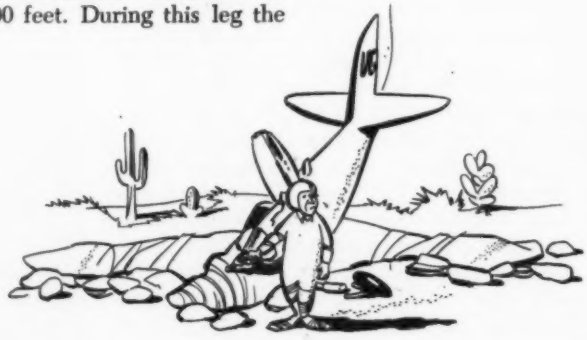
At destination a hard landing damaged the nose gear and tore away the port main gear. Headquarters Central Air Sea Rescue recommended the best available bailout location and the crew bailed out successfully. The aircraft crashed and exploded in an open field.

The flight surgeon says that fatigue, decreased perceptual ability and depth perception no doubt were factors contributing to the accident. (The pilot's working day was approximately 17 hours.)

As the second endorser to the AAR states, "In view of the fact that the aircraft was flown at altitudes above 5000 feet at night it is agreed the pilot exhibited poor judgment in not requiring the possession (and use) of proper oxygen equipment by all crew members."

'Subtle Invader'

COMMENTING on an accident in which the pilot made a hard landing aboard the carrier during night carquals, the in-



from your flight surgeon

vestigating flight surgeon had the following to say:

"Fatigue could have indirectly affected this pilot's performance. Though he did get eight hours of sleep he was not adequately rested or refreshed before commencing an initial night carrier landing, the most demanding and challenging aspect of naval aviation. He had been on continuous duty for a 12-hour period either acting as squadron duty officer or flying. Fatigue is very likely to be a by-product of such a schedule. Fatigue is a subtle invader that can dull the mind, delay reflexes and cause errors of attention and performance.

"*Recommendation*: The problem of fatigue should be re-emphasized on squadron level on a continuous basis by both the flight surgeon and the safety officer. The importance of an aviator being well-rested before undertaking a difficult flight cannot be overstressed."

Extensive Burns

SHORTLY after takeoff, an A1E burst into flames when it struck the runway, left wing first. Although the fire on the left side of the aircraft was considerably more extensive than on the right, the pilot exited through the left. *He was not wearing a helmet or gloves on this flight.* Second and third degree burns of his face, neck, hands, arms and body will hospitalize him approximately a year. According to the reporting flight surgeon's estimate, the pilot's burns will probably ground him indefinitely.

"Classical Ring Injury"

WHILE jumping from the port cargo door of a UH-2A, an airman lost his balance and fell to the ground. Getting up, he walked to the front of the plane where he paused to look at his watch on his left hand. It was then that he saw that most of his fourth finger was missing.

The flight surgeon reporting this case describes it as a "classical ring injury." The man wore his wedding ring loose because of an enlarged finger joint. As he lost his balance while trying to jump, the ring caught on the latch edge of the door. He hung momentarily by his ring and finger before the finger broke off.

One Cylinder

A CREWMAN escaping from a sinking helicopter pulled the toggles on his life vest, surfaced, and inflated and boarded his pararaft. He was rescued by motor whaleboat 50 minutes later. At that time it was discovered that one of the CO_2 cylinders on his life vest was missing.

It pays to preflight your life vest *every* time you fly!

Cigarette Lighter

ON a practice night hover, a helicopter settled into the water off shore and came to rest on its port side. The pilot and crewmember in the cockpit exited on the pilot's side. The crewmember in the cabin exited by the compartment door.

In violation of OpNav Instructions and station policy, life vests were not worn by the three men on this flight. After the accident, on the pilot's decision the vests were left in the aircraft because the water was shallow enough for them to wade to shore. None of the men remembered the signal devices on the vests.

They were rescued when the SAR pilot spotted the flame of the downed pilot's cigarette lighter.

Sleep

ON INVESTIGATION of a gear-up landing, the board found that the pilot had slept only 3 hours and 15 minutes in the 32 hours preceding the incident:

Aircraft Accident Board recommendation: "Pilots and RIOs involved in carrier qualifications should have a minimum of 6 hours of unbroken sleep out of each 24 hours of operations. Schedules and watches should be so arranged as to permit this. Since aircrews are not normally performing full collateral duties during carquals, they should be reminded to take advantage of any slack period in operations to catch a few minutes of extra rest or sleep."

Keep Your Helmet

A SURVIVOR from the crew of a ditched helicopter took off his helmet as he left the aircraft. During rescue, helicopter down wash blew an empty life raft on top of him. His head was cut by the raft CO_2 bottle.

CHECK YOUR TRANSMISSION

By N. C. MacPhee
20 KVA Installation and Service Support
General Electric Company

Constant speed drives are hydraulic transmissions and must have oil.

During 1962-63, one out of five F-4B CSD removals has been found to be the result of low oil supply. The CSD on this airplane uses the engine lube tank and some of the CSD failures can be traced to leaks in the lube system. However, *many of these CSD failures could have been prevented.*

There are seven ways in which you can save yourself the extra work of unscheduled removals, improve reliability and save money.

1. Proper Oil Servicing
2. Careful CSD Priming
3. Strict Oil Service Cart Maintenance
4. Alert Lube System Troubleshooting
5. Careful Hydraulic Nozzle Priming
6. Correct Lube System Flushing
7. Attention to CSD s Suspected of Low Oil Supply

Lube System Servicing

One of the most effective tools that can be used in maintaining and troubleshooting the J79 engine is an accurate oil consumption record.

This record shows trends that will indicate impending problems and will show immediately when a failure has occurred even though there were no

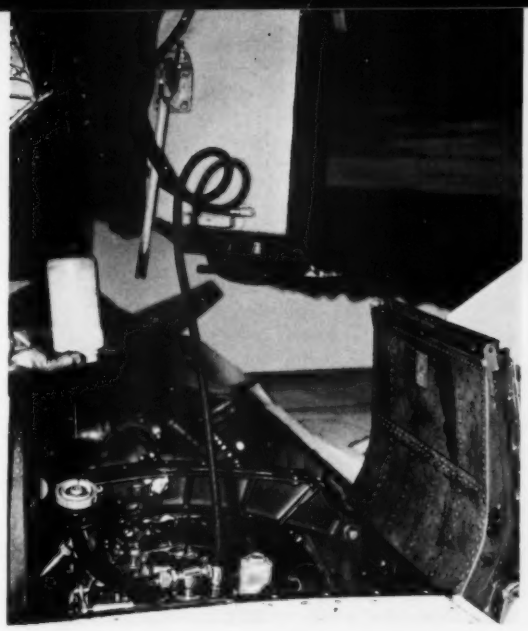
indications in flight. In order to maintain an accurate record it is necessary to have accurate servicing. Accurate servicing will be obtained by using properly working oil service equipment, maintaining it and by using correct servicing procedures.

To determine that the equipment is functioning properly, close the bleed valve (if so equipped), set the indicator to the starting mark, and pump oil into a one quart or one gallon container. The amount indicated and the amount pumped should agree. Never let the oil level in the supply tank get low—some carts will not indicate proper flow if oil level is low and will allow air to be drawn into the pumping system.

To properly service an engine:

1. Look in the oil tank of the cart to determine that there is enough oil for a complete normal servicing operation. This is to insure no air will get into indicator system.
2. Set the indicator to the starting mark.
3. Make sure bleed valve on cart is closed.
4. Connect the overflow line. Make certain the quick-disconnect is engaged. There will be some oil flow into the bottle when connection is made. This is normal. (See photo this page).
5. Connect the fill line and immediately start pumping oil into the engine. Pump until there is a sufficient overflow from the overflow line. Sometimes there will be a small trickle of oil out the overflow line before the tank is completely full. This is residual oil in the line. Don't stop until there is overflow of ½ pint more than residual oil already drained.
6. As soon as there is sufficient overflow, stop pumping and immediately disconnect the fill line to insure no back flow into the oil cart.
7. Allow the overflow line to drain and disconnect it.
8. Measure the total overflow.
9. Subtract the total overflow from the amount pumped into the engine. This amount is the oil added to the engine.
10. Record this on the appropriate form.

Normally the engines are serviced within 15 minutes after shutdown. Sometimes this can't be accomplished and the aircraft sets several hours before it is serviced. When this happens the possibility that improper servicing will occur is much higher. Oil sometimes leaks through the main lube and hydraulic pump and filters and collects in the gear boxes. Therefore when an engine has been idle for several hours or days and if the engine were serviced in this condition oil usage could appear high. Start the engine and run at idle for one minute to scavenge all the oil back to the tank, an alternate procedure, if desired, is to drain the gearboxes and measure the oil drained from them. Subtract this amount from the oil added to the engine to arrive at the actual amount of oil added to the system.



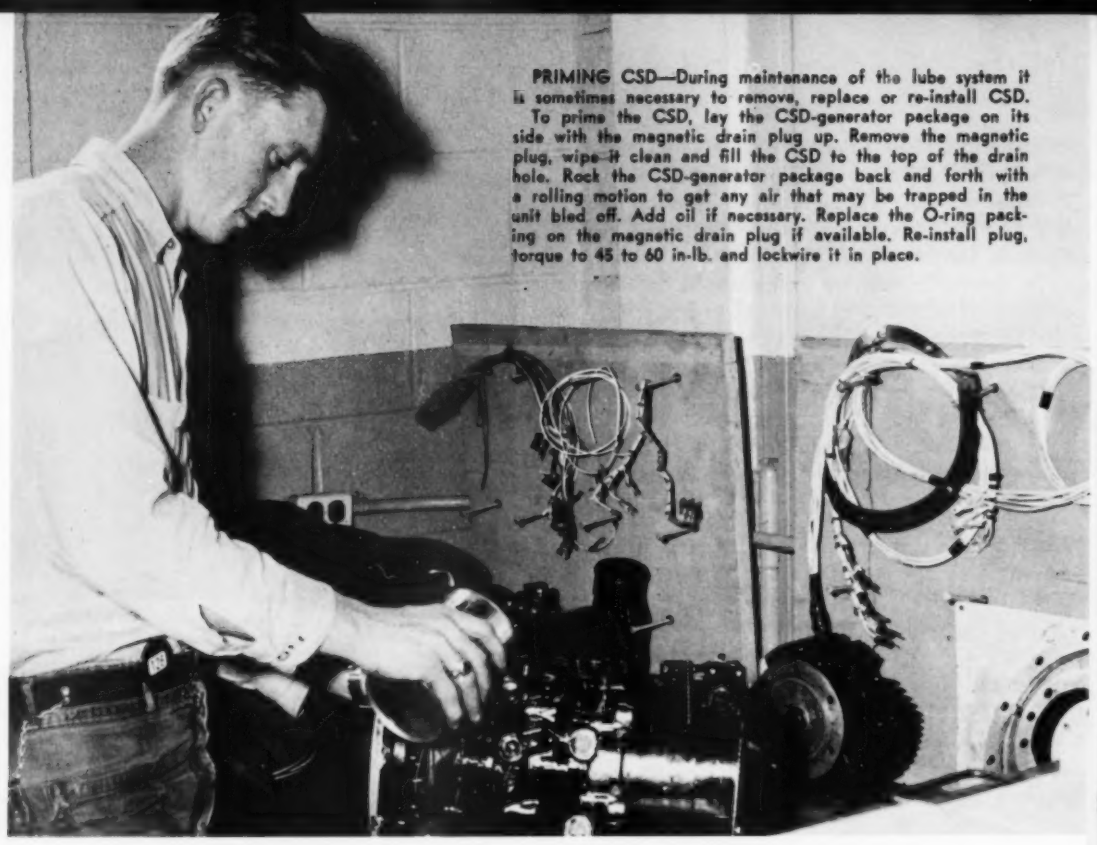
When connecting the oil service cart, there will be some minor flow of oil from the overflow line. *This does not mean the tank is full.* Pump oil into the tank until at least a pint of overflow oil is obtained in addition to the residual oil in the line.

Priming CSD on Aircraft

1. The CSD-generator combination is installed as a package.
2. Attach oil-in line at CSD; tighten B-nut finger tight.

Note.—At the time of the previous CSD removal, the oil-in line should have been disconnected to prevent oil from siphoning out of the tank. *Reconnect the quick-disconnect fitting.* Be sure that prongs of quick-disconnect protrude; this indicates that the disconnect sections are properly mated.

3. Attach the CSD oil-out line. Tighten to a torque value of 250 to 300 in. lb.
4. Service the engine lube tank in accordance with NavWeps 01-245FDA-2-4, Section IV for the J79-2 or NavWeps 01-245FDB-2-3.1 for the J79-8 engine. Loosen the nut on the CSD oil-in fitting and allow oil to drain from loose connection. If CSD oil-in line does not prime, complete the oil servicing operation and recap the oil fill and drain fittings. Apply a pressure of about 2 psig to oil tank vent line; this should prime the CSD oil-in line. *Allow at least one*



PRIMING CSD—During maintenance of the lube system it is sometimes necessary to remove, replace or re-install CSD. To prime the CSD, lay the CSD-generator package on its side with the magnetic drain plug up. Remove the magnetic plug, wipe it clean and fill the CSD to the top of the drain hole. Rock the CSD-generator package back and forth with a rolling motion to get any air that may be trapped in the unit bled off. Add oil if necessary. Replace the O-ring packing on the magnetic drain plug if available. Re-install plug, torque to 45 to 60 in-lb. and lockwire it in place.

quart of oil to drain from loose inlet connection and then, with oil still flowing, tighten nut to a torque value of 480 to 840 in. lb. Failure to prime indicates a problem in the oil supply lines, possibly the quick-disconnect or the flexible CSD oil pickup internal to the engine lube tank.

5. Disconnect the oil line to the CSD discharge filter; this is the line coming from the CSD.

6. Place a no. 8 cap on the CSD filter inlet elbow so that during priming, oil is not allowed to drain from the tank through the CSD filter. The cap can be hand-tight.

Note.—The location of the oil inlet and discharge lines varies between models of aircraft. On F-4A aircraft with J79-2 engines, the CSD discharge filter is in a difficult location. The discharge line should therefore be disconnected at the CSD outlet fitting. Plug the oil return line with a no. 8 plug during the air motoring operation. A short length of hose can be attached to the CSD oil outlet and drained into container.

7. Place a container under the open fitting and motor the engine with air until a steady flow of oil is discharged.

8. After the engine stops windmilling, wait a few moments until the oil tank pressure has a chance to equalize with the atmospheric pressure. Remove the cap on the inlet to the CSD oil filter. Some oil will drain from the filter.

Note.—When reconnecting the oil-out line after air motoring the engine wait until the oil flow stops; this will preclude spraying oil around the engine compartment.

9. Reconnect discharge line and torque the B-nut to 250 to 300 in. lb.

10. *Reservice the Engine Oil Tank.*

Note.—ASC 90 provides a single fill-drain line connected to the bottom of the lube tank. The PON-5 oil service cart has a bleed valve which can allow the tank to drain back into the cart if the fill line is not disconnected immediately after servicing. As a precaution, some activities have this bleed valve lockwired closed.

Maintenance Schedule for Oil Service Carts

Maintenance of the oil cart is absolutely essential to obtain accurate servicing. Therefore the following maintenance schedule is presented.

1. Check oil level in tank as often as necessary in

order to assure that there is adequate oil for any servicing operation to be performed.

2. Empty the overflow tank regularly and assure the quantity indicator on it is readable. Make certain no grit is in the vent on the bottle, if used.

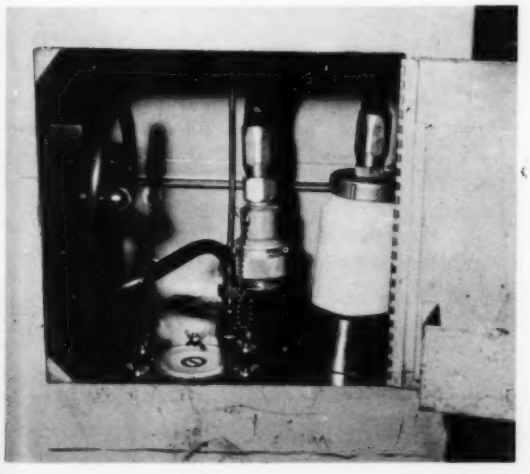
3. Always use the caps and plugs on service fittings to insure fittings are clean. These covers are supposed to be attached to the servicing cart and are also on the airframe. Before each use of the cart inspect fittings for cleanliness. Don't attach any cart to dirty aircraft fittings. This is particularly important since all the engine oil system filters are downstream of the lube pumps and contamination such as sand and dirt will shorten the useful life of these components.

4. *Daily*: Inspect hoses and fittings for leakage. Repair immediately. At least once a day inspect service quick-disconnect units for proper operation.

5. *Weekly*: Set aside a few minutes to clean the whole cart and wipe off the accumulation of dirt. Clean the service fittings and give them a thorough operational inspection. Check the oil tank internally for contamination. Make sure the bleed valve is closed.

6. *Weekly*: Calibrate the quantity indicators by pumping two quarts or more into a container of known size. The quantity pumped and the quantity indicated must agree or the cart should be removed from service for repair.

7. *Monthly*: Replace the cart oil filter; sooner if required.



Keep oil service carts clean. Have protective caps chained to the oil connections—use them.

High Oil Consumption Troubleshooting

To differentiate true oil consumption from apparent oil consumption accurate records are most helpful. Good records coupled with good servicing procedures will eliminate any need to risk millions of dollars worth of equipment for just one more flight to find out if it was really improper servicing.

When high oil consumption occurs:

1. If the CSD or nozzle pump failed, clean all filters and flush engine.

2. If oil used is 3 gallons or more, drain gearboxes. If more than 2 quarts are found in the gearboxes, check for faulty scavenge pumps or main lube and hydraulic filter anti-leak valves. If residual oil quantity is normal continue troubleshooting.

3. Run the engine to make an adequate leak check on the engine. When leaks are found, if they are not estimated to be compatible with the amount of oil lost, continue troubleshooting.

4. Pressure check the gearboxes by pressurizing them to 5 psi. Check the common drain line. If leakage occurs isolate the specific accessory seal causing the leak and change the gearbox.

5. Install a pressure gage at the reference pressure line of the oil pressure transmitter and measure common sump pressure.

6. If common sump pressure is normal drain the gearboxes. Accurately service the engine. Make an oil consumption run.

7. If after doing all of the above, no cause for consumption can be found, it is necessary to remove engine to isolate the engine fault.

8. Install the engine on a test stand and measure individual sump pressures.

9. If the engine cannot be installed on a test stand for the individual sump check make a static carbon seal check using a carbon seal tester.

10. If after performing all the above checks the problem cannot be isolated, reject the engine to the next higher level of maintenance.

Priming Hydraulic Nozzle System

When any component in the hydraulic system is replaced or when lines are broken in this system the following procedure should be performed after work is completed.

1. Fill oil tank.

2. Loosen the hose between the pressure relief valve on the rear gearbox scavenge pump and the

oil inlet manifold hose to the pump at the tee on the manifold hose. Be certain the coupling is backed off far enough that it will leak when pressure is applied.

3. Connect exhaust nozzle actuator tester at pressure taps on the actuator lines and pump the nozzle open then closed until oil is running from the loosened connection at the pump inlet. Tighten connection and torque it.

4. Pump the nozzle full open. Disconnect test hoses and cap the pressure taps immediately.

5. During prestart dry motoring loosen the inlet hose to the nozzle pump at the manifold hose tee again and motor the engine until about ½ pint of oil has drained to insure that the line between the hydraulic pump and nozzle pump is full. While still motoring tighten the connection to the inlet of the nozzle pump. Then stop motoring the engine. Reservice the oil tank.

Flushing Lube System After a CSD Removal

A. In all instances of a CSD failure, remove and inspect the CSD return filter. If it is free of metal particles, and examination reveals no bypassing has occurred, no further action would be required other than clean or replace filter. Filters should be cleaned with ultrasonic cleaning equipment.

B. If metal contamination is evident on the CSD filter, the filter must then be examined under a strong light. If close inspection reveals the presence of a varnish-like substance, it must be assumed the filter went into bypass, further contaminating the engine main lube and hydraulic systems. Replace the filter.

C. If there is evidence of the CSD filter having gone into a bypass condition, the following action should be taken:

1. Inspect the inlet screens of the main lube and hydraulic pump.

2. Inspect the main lube and hydraulic pump discharge filters.

3. Inspect the scavenge oil filter.

4. Inspect the nozzle bi-directional filters (J79-8 only).

5. Inspect the nozzle pump magnetic plug (J79-8 only).

Contaminated filters should be cleaned or replaced as necessary in accordance with approved engine instructions.

D. The condition of the main lube and hydraulic pump filters is important. If contaminant is present, it will have passed through the oil tank and some may have been deposited there with the possibility of being passed through the CSD supply system to the drive.

1. Remove the CSD. Allow the CSD supply line to drain, then blank off the line.

E. Drain the hydraulic and main compartments of the oil tank. To drain the hydraulic compartment on installed engines, disconnect the hydraulic supply line from the tank at the main lube pump.

F. While the tank drains are open, flush the oil scavenge lines and coolers as follows:

1. Disconnect no. 1 bearing scavenge pump outlet line.

2. Connect an oil pressure source (1C3569) to the line.

3. Disconnect the scavenge line from no. 2 and no. 3 sumps at scavenge filter. Cap off the tee-connection.

4. Pump oil through no. 1 scavenge line. It will flow through the lines and oil coolers, into the tank and out of the open drains.

5. When the oil draining from the tank is clean, remove the oil pressure source and reconnect the no. 1 bearing scavenge pump outlet line.

6. Reconnect the scavenge line from no. 2 and no. 3 sumps to the scavenge filter.

7. Connect the hydraulic supply line at the main lube pump.

G. Refill the tank with clean Mil-L-7808 oil. Disconnect the oil service cart.

H. Loosen the main lube pump hydraulic supply line at the pump and allow about ½ pint of oil to drain to assure that there is no air in the hydraulic supply system.

I. Remove the scavenge oil filter bowl and element. Place a container under the filter.

J. Remove the CSD oil filter bowl and element. Place a container under the filter. It may be necessary to use aluminum foil or similar material to help funnel the oil from the filters into the containers.

K. Motor the engine as follows:

1. Place the engine master switch OFF.

2. Pull out ignition circuit breaker.

3. Motor the engine for one minute.

4. Assure that the oil coming from the scavenge and CSD oil filters is being caught in the containers.

5. While motoring engine, advance the throttle to MILITARY and hold until the exhaust nozzle stops moving closed.

Note.—If the aircraft is located where the throttle cannot be opened, because of fuel drainage and fog,

close the exhaust nozzle by manually stroking the nozzle pump. To close nozzle, push nozzle pump control lever up (retract nozzle area control output rod); to open, pull control lever down.

6. Retard throttle to CUTOFF, or pull the nozzle pump control lever down to position the exhaust nozzle open.

7. After one minute of motoring, turn off starter air.

8. Refill oil tank with Mil-L-7808 oil.

9. Discard all oil that was caught at the filters.

10. Accomplish this motoring procedure twice to assure adequate flushing.

L. Clean the following magnetic plugs and filters:

1. Main lube discharge filter.
2. Hydraulic discharge filter.
3. Transfer gearbox magnetic plug.
4. Nozzle pump bi-directional filters.
5. Nozzle pump magnetic plug.

M. Inspect the nozzle pump hydraulic supply hydraulic relief valve for contamination. If contaminated, replace valve.

N. Prime the nozzle hydraulic system. Service the oil tank and disconnect the oil service cart.

O. Replace the CSD and Scavenge Filter bowls and elements.

P. Plug the CSD oil inlet and outlet lines.

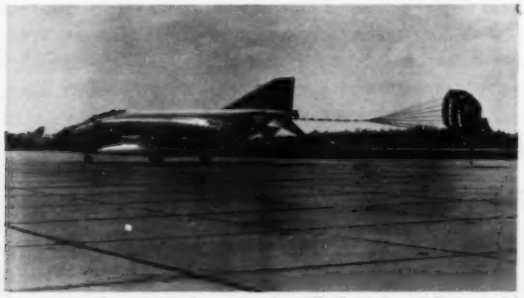
Q. Run the engine for 10 minutes, and check for normal oil pressure.

R. After shutdown, reinspect the magnetic plugs and filters.

S. If contamination is still present, replace the suspect component and repeat flushing procedure. If the contamination is being generated in one of the bearing areas or gearboxes, reject the engine to the engine shop for further investigation.

T. Reinstall the CSD and prime CSD system.

U. Reprime the nozzle hydraulic system. Service the oil tank and disconnect the oil service cart. Perform an engine running leak check.



Accurate oil consumption records will show impending problems even though there were no indications in flight.

Flushing the Lube System

A complete inspection of all lube system filters should be made after failure of a lube system component. If the engine scavenge filter is heavily loaded or is suspected of having bypassed then the CSD should be removed and the detailed procedure given in paragraphs D through U above should be followed.

Checking Engine Suspected of Oil Starvation

1. The engine lube tank has a usable capacity of 5.3 + 0.2 gallons of oil when filled to the level of the tank overfill. This is 42.4 + 1.6 pints. The oil level of the CSD pickup is at 25.6 pints which would indicate that the system could lose 16.8 pints before this pickup would start to suck air. However, this point is affected by aircraft attitude, G-loadings, aeration or foaming, and tank pressure. In addition, the engine has a gulp factor of 0.7 gallons; this means that the engine will pull 5.6 pints out of the tank during operation and then return it to the tank as the engine coasts down to a stop. All variables considered, it is possible for the CSD to be pulling air if the oil tank is found to be down 14 pints when the engine is serviced within the specified 30 minutes after a flight.

2. If the engine lube tank requires 14 or more pints of oil, remove and inspect the CSD discharge filter element. If this element or filter bowl has an accumulation of metallic contamination, remove the CSD for bench check.

3. If filter and bowl are clean or have only minor evidence of contamination, replace them, reservice the lube tank and run the engine for 10 minutes.

4. Connect the PSM20A test set per instructions of NavWeps 01-245FDB-2-5.1.

5. Set PSM20A test set to read line voltage of the suspect CSD/alternator and monitor output frequency. Remove the connector from the frequency and load control box.

6. The frequency during this run must be 400 + 4 cps. If frequency exceeds this limit, remove the CSD/alternator package and send to bench check.

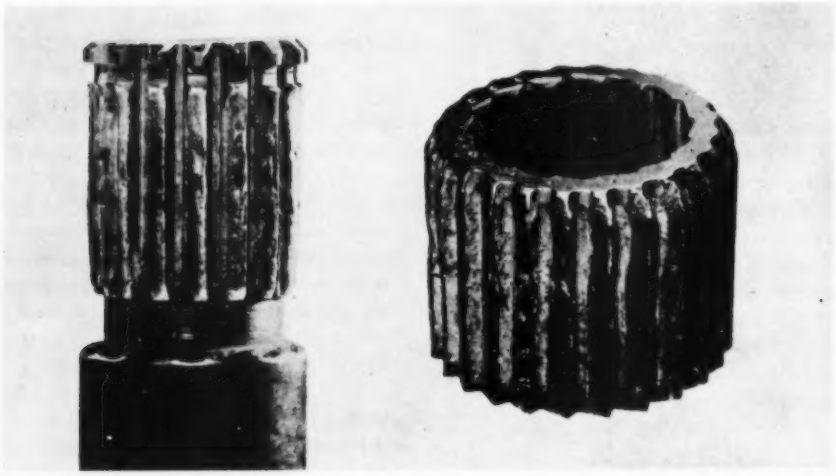
7. After 10-minute engine run, recheck filter and filter bowl; if there is any accumulation of metallic contamination, remove CSD and send it to overhaul.

8. If frequency remains within 400 + 4 cps and filter is clean, *CSD is serviceable and may remain in aircraft.*

Higher speeds and powers with today's drives have made spline requirements more critical, increasing the possibilities of excessive spline wear. Here's an informative discussion of problems involving design, spline alignment and lubrication.

SPLINE SHAFT WEAR

Courtesy of DESIGN NEWS and Edwin R. Judkins
Pesco Products Div., Borg Warner Corp.



Fretting corrosion is another form of wear experienced with difficult spline applications, particularly those subject to vibration. In fretting, slight relative motion between mating spline teeth causes galling.

Galling in turn tears out tiny particles, which oxidize and cause further wear. Although fretting corrosion may not be entirely eliminated by lubrication, its effects will be significantly mitigated.

The problem is particularly serious in aircraft and missile applications where adequate bearing support and positive lubrication conditions are difficult to achieve.

Primary factors that influence spline wear are unit loading on spline teeth, relative axial and radial motion between mating spline parts, lubrication, material selection and vibration. Of these, both unit loading and relative motion are aggravated by misalignment. The presence of even moderate vibrating forces increases the possibility of fretting corrosion.

In general, spline profiles such as the SAE Standard 30-degree pressure angle involute provide many characteristics that tend to minimize wear and increase reliability. These include maximum strength across the minor diameter, self-centering action that tends to equalize bearing and stress between teeth, load-carrying capacity that minimizes axial strength requirements and a 25 percent tooth contact under average conditions of machining inaccuracies. Calculations based on these characteristics are only valid if adequate bearing support can be provided to maintain good alignment, insuring full tooth contact and minimum loading.

Misalignment

There are three kinds of misalignment possible between splined members:

1. Angular misalignment in which the spline axes

intersect at an angle.

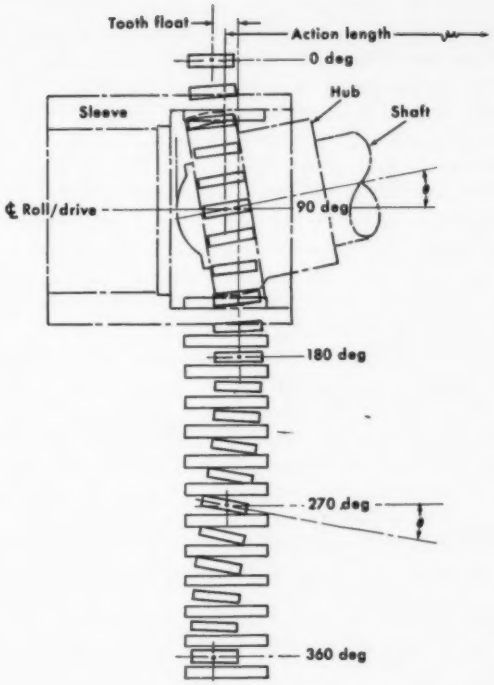
2. Offset or axial misalignment in which the spline axes are parallel, but offset relative to each other.

3. Offset and angular misalignment, a combination of the two just mentioned.

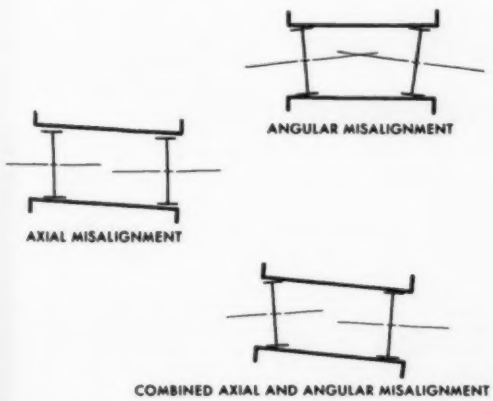
If sufficient backlash is also present between splined members the effect of any of these conditions will probably be angularity. Where an O-ring is included between the coupling and drive shaft to retain grease or engine oil, high O-ring compression would make it nearly impossible for the coupling to assume an angle between driving spline and driven spline. Under this condition, misalignment is nearly 100 percent offset and must be absorbed entirely by the internal splines of the driven component.

Forces developed between misaligned components tend to cause axial and radial movement between contacting tooth surfaces. The greater the misalignment and consequent relative displacement, the greater the work available for metal removal. These displacements always are accompanied by increases in unit loading. In angular misalignment, unit loading is by reduction in area of contact and in offset misalignment by reduction in the number of teeth carrying the load.

One method of improving spline alignment, says the author, is to machine the components with sufficient offset to compensate for bearing and journal clearances. By doing this, the components will run within a few thousandths of true alignment under pressure. Although this precision machining adds to the cost of producing a unit, longer operating life and lower overhaul costs may make it worthwhile. Among other production methods suggested by the author are increasing the length of the connecting shaft, crowned external splines, use of crowned muffs or adaptors between splines, universal joints and couplings. All of which increase weight and cost, and must be evaluated carefully.



Effect of angular misalignment is shown by developed view of mating teeth. Net effect is constant change in angularity of contact during rotation. This effect reduces tooth contact, increases unit loads, breaks oil film impairing lubrication and causes relative motion between contacting tooth surfaces. Under high load (torque) conditions, wear can be expected to develop at excessive rate.



Lubrication

Lubrication is a most important factor governing spline wear. The fact that very little wear is experienced with automobile splines is undoubtedly because of the excellent lubrication provided.

Further proof of the importance of lubrication is provided by research studies proving that internal splines of aircraft fuel pumps operating submerged in fuel have lasted for thousands of hours. Only the low viscosity fuel itself acts as a lubricant.

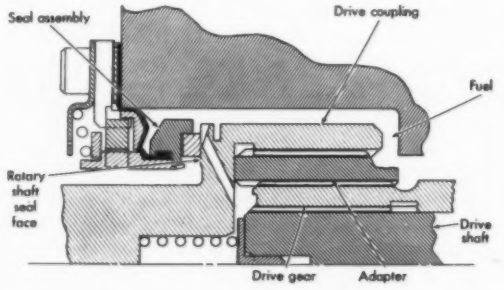
External splines that depend upon periodic maintenance for lubrication often are a difficult wear problem. If they are overlooked when scheduled for lubrication, short service life results. Extensive field ex-

perience has shown that, in some cases, sets of splines seldom lubricated have been so badly worn that the teeth were no longer engaged. When the splines were removed, the adaptor and mating spline were so filled with iron oxide from wear and corrosion that it was difficult to separate the two parts.

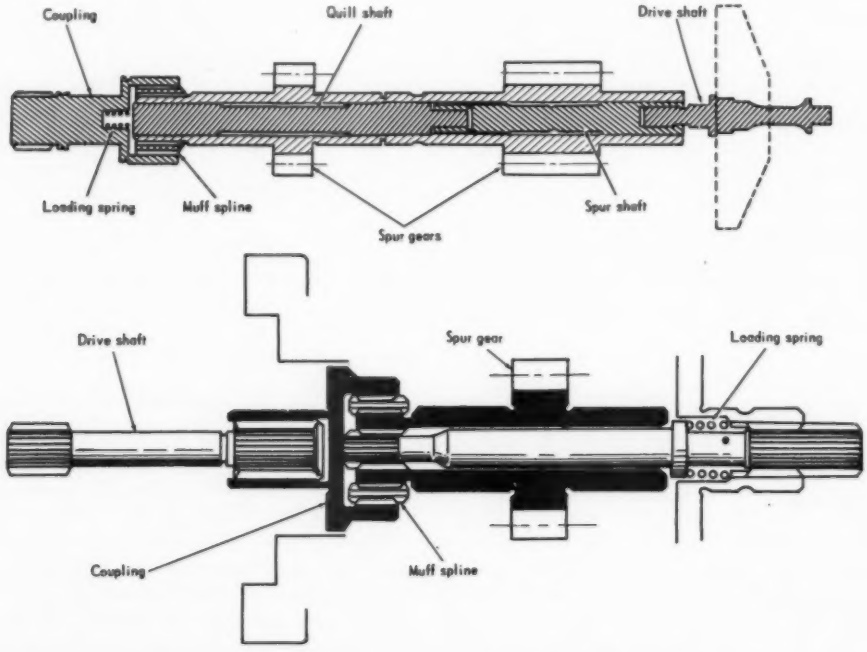
One solution to the lubrication problem is the incorporation of an O-ring dam between the coupling and drive to retain grease or engine oil. When properly designed, with low radial squeeze on the O-ring, this method can offer substantial improvement by assuring positive lubrication.

Internal splines that are continually bathed in a lubricating liquid, even in low viscosity fuel, experience longer life. However, a greater degree of improvement may be realized by forcing a flow of lubricant past the splines. Positive lubrication may be accomplished by centrifugal force or by suitable venting from high pressure to low pressure areas.

Along with lubrication, decrease in the coefficient of friction can be obtained by chrome flash-plating the spline teeth. This flash is normally 0.00005- to 0.00015-inch thick. In bench rig misalignment testing conducted during a research study, plating showed a substantial improvement in reducing spline wear. These results have been substantiated by field service experience in aircraft application.



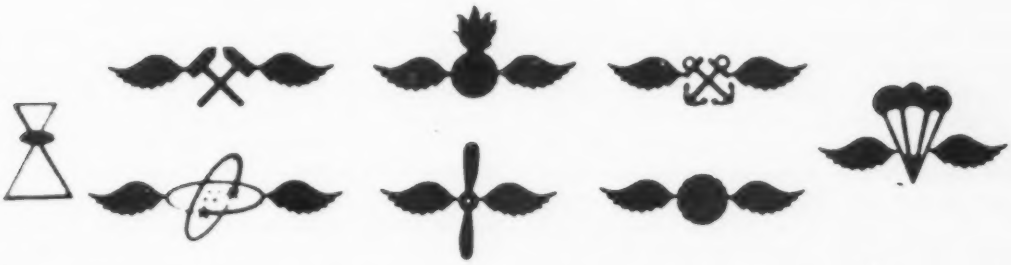
Forced-lubrication splines improve performance life. This design using centrifugal force has advantage of cooling rotary shaft seal face.



Drive train of gear-type afterburner pump (top) combined with main engine fuel and booster pump. Oil pressure lubricates spline mating engine.

Drive train also uses internal "crowned muff" to reduce working of spline teeth caused by misalignment. Lubricated, crowned jack shaft (bottom) between engine drive and pump coupling will minimize misalignment effect between engine and pump.

108 Maintenance Goofs



Maintenance errors, costs and injuries rose sharply during the second quarter of Fiscal 64—108 mishaps compared to 76 for the previous quarter. One fatality was reported which occurred when a maintenance man unintentionally ejected himself while arming an ejection seat.

Flight control malfunctions continued to be the cause of the greatest number of accidents during this quarter. Two aircraft were lost as a result of missing or improperly installed safety locking devices. Twenty-two panels and hatches were lost as a result of improper security.

The majority of the errors listed are repetitive ones that have been reported time and time again. Will *you* contribute to another one next quarter?

A-3

1-3. On three occasions access doors were lost in flight due to failure to properly engage fasteners and omission of inspections. All E damage.

4. Misrigging of throttle control linkage caused flameout and aborted flight.

A-5

1. A failure to properly latch Aero 8A container to MAU9A rack resulted in loss of container and bombs.

2. Incomplete installation of nose cover panel resulted in E damage.

A-4

1. A *failure to refill engine oil system* resulted in a damaged engine which required replacement.

2. A failure to secure fuel cell filler cover resulted in loss of cover.

3-4. Murphy's Law—Cross-connecting emergency and primary circuit cannon plug leads resulted in loss of two practice bomb racks and stores.

5. Radome was lost in flight due to a failure to lock the latches and the omission of inspection. E damage.

6. Improper installation of bomb rack resulted in loss of rack fuel tank and resulted in D damage.

7. Harness bracket jammed aileron controls as a result of improper installation/security. Flight aborted.

8. A failure to remove masking tape from a fuel vent mast resulted in overpressurized/ruptured tank. C damage.

9. Failure to install ground safety pin/disconnect electrical lead to bomb rack resulted in E damage.

10. A failure to secure wing electrical access door resulted in D damage.

11. Failure to reinstall fuel cap resulted in E damage.

12. Oil system was not properly serviced. Engine replaced.

13. Aileron buckled due to improper repairs.—E damage.

14. An attempt to remove an external fuel tank before looking into it resulted in a ruptured tank containing 300 gallons.

15. Improper incorporation of armament material change caused loss of store.

16. Improperly adjusted canopy handle. Canopy lost in flight.

17. Improper servicing of the main landing gear resulted in C damage.

Missing Cotter Pin

FOLLOWING maintenance on an A-4E involving its fuel control unit the aircraft was launched for a test flight. After 50 minutes of flight and as the pilot approached the 10-mile initial the throttle linkage became disconnected. The disconnect left the engine running at 85% power.

Declaring an emergency the pilot requested a morest landing. Upon engaging the arresting gear the pilot used the Emergency Shutoff Valve to stop the engine. No damage was incurred but it took nearly three minutes for the engine to wind down. (*It is possible the control was not completely in EMERG OFF or, the shutoff valve was misrigged. The flight manual cautions: "To ensure complete fuel shutoff, the control lever must be moved fully aft into EMERG OFF detent. Normally, the time interval from actuation until engine deceleration is about 4 seconds."—Ed.*) Cause of the throttle disconnect was the omission of a cotter pin permitting the nut to back off and the bolt to fall out of the linkage.

"We feel lucky about this mishap," reports Anymouse, "and we learned several things from it—namely":

1. The Manual Fuel Emergency Shutoff Valve will not shut down the engine as rapidly as the pilot thought it would,

2. QC inspectors should be more meticulous about inspecting obviously critical items following maintenance.

18. Failed to install ground safety pin in main landing gear. Gear collapsed. D damage.

19. A failure to tighten one of 12 wheel bolts resulted in *strike* damage.

F-1

1. Installation of wrong type wheel bearing resulted in locked wheel and damaged assembly.

2. Radar access panel was lost due to improper security. E damage.

F-10

1. Lower escape door was lost in flight due to failure to engage release cable.

2. Lower escape door was lost in flight due to improper installation. E damage.

F-4

1. Failure to secure oil overboard vent drain cap caused temporary loss of throttle control and FOD.

2. Failure to lock missile wing in position resulted in E damage to aircraft.

3. Fuel drain valve was found lockwired in the open position with a cap installed during check. No damage.

4. Fire warning element crushed by door 96 caused fire warning-engine secured.

5. Nut left loose on oil line to scavenge tube. Engine shut down—FOD.

6. Supervisory, failed to install duct screens or turn-up. Failed to use safety observer. B injury.

7. Dropped tail hook on crewman's foot. E injury.

F-8

1-2. Gun/ammo access doors lost in flight as a result of inadequate security and inspection. Both E damages.

3. Murphy's Law—Crew installed hydraulic check valve backwards during incorporation of ASC-424. Gear-up arrested landing; E damage.

4. Wing outer panel was allowed to strike aileron during fold cycle. E damage.

5. A failure to remove spilled fuel or oil from tail section resulted in D damage.

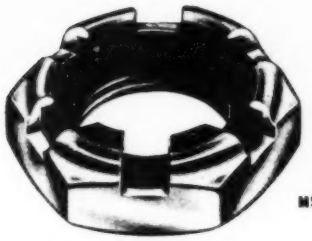
6. Failure to determine the cause for a canopy malfunction resulted in loss of canopy. E damage.

7. Static vent holes were left covered with masking tape. D damage.

8. Crew failed to properly install the tab lock washer and jam nut with lockwire on aileron control rod end (tab was not inserted in rod slot/inadequate torque). *Strike* damage.

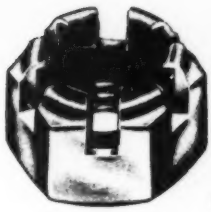
9. *Failure to install cotter pin in throttle linkage* caused loss of control/aborted flight.

10. Crewman's failure to install safety pin in fir-



MS 17828

NEW
Fail-Safe Nuts



MS 17825

Nylon insert self-locking castellated nuts add new dimension in safety and reliability.

▶ *Agreed, Anymouse, you were lucky. There were 9 accidents during a recent 15-month period in which 9 aircraft were lost—9 million dollars* lost due to the omission of 9 cents worth of cotter pins! *Following the loss of an F-4, BuWeps directed that self-locking castellated nuts, MS 17825, be installed in lieu of standard castellated AN nuts. Use of the self-locking castellated nuts will prevent them backing off in the event cotter pins are left out* (October '62 issue of APPROACH). *F-4 Airframe Change 155 of April 1963 states the new nuts are available through normal supply channels.*

In the case you mention, and all of the others with the exception of the F-4, the most important lesson is being overlooked—effects of human errors of this kind can be minimized through the use of improved hardware.

It would appear that what is good enough for the F-4 ought to be good for other model aircraft. Perhaps effort on the part of operators to secure authorization to use MS 17825 nuts in approved locations on their aircraft will bring about a solution to this problem.—Headmouse

ing head of ejection gun resulted in E damage/*fatal* injury.

F-9

1. Failure to lubricate the main landing gear uplock assembly resulted in E damage.
2. Failure to install canopy locks resulted in severe injury.

F-11

1. Stabilizer follow-up rod left loosely connected. *Strike* damage.

T-33

1. During turnup after the engine was cleaned with kerosene; fire caused E damage.

T-1A

1. Hangar doors were closed on detached tail section. E damage.
2. Maintenance man failed to properly connect fuel quick disconnect. A damage.

T-2

1. Engine duct cover was not removed from aircraft prior to turn-up.

A-1

1-3. Failure to secure and visually check engine cowling latch and access panels resulted in E and D damage.

4. External store was lost due to failure to thoroughly inspect rack which was faulty.
5. Plane captain rotated canopy hinge closure jettison catch so locking arm would not engage. E damage.

B-26

1. Improper security and omission of inspection resulted in loss of engine cowling. E damage.
2. Failure to properly install and inspect nose gear scissor locknut and safety pin resulted in E damage.
3. Improper installation and security of nose gear torque arm pin resulted in E damage.

C-131F

1. An engine was secured in flight due to misadjustment of oil cooler door actuator.

P-3

1. Supervisory failure to provide proper tools and improper brake adjustment resulted in brake failure. E damage.
2. Failure to grease bearings when changing wheel. E damage.

P-2

1. Failure to torque PRT clamp nut and *failure to install cotter pin* resulted in E damage.

2. Radioman escape hatch lost in flight due to failure to engage latch.

3. FOD. A 10/32 steel bolt caused oil pump failure and recip engine failure in flight.

4. Use of a jet engine installation and removal truck with loose attachments. E damage.

5. Fuel control nuts were left loose allowing fuel to leak, causing explosion and aborted flight.

P-5

1. Incomplete installation of plug assembly for drift sight standpipe. D damage.

2. Damaged propeller while moving work stand. Supervisory error.

C-47/C-117

1. Crew left hot lead hanging loose which shorted out A.C. and D.C. power. F damage.

C-54/C-118

1. Loose cylinder intake pipe resulted in feathered engine.

2. Crewman allowed aircraft to roll forward and strike another crewman. B injury.

C-45

1. Oil line was left loose, secured engine and precautionary landing made.

S-2/C-1

1. Improper installation/security allowed in flight loss of no. 4 operator's hatch. E damage.

2. Improper locking procedure and too much slack in MAD boom cable resulted in D damage.

3-4. Two failures to torque shaft nuts resulted in loss of two torpedo air stabilizers in flight.

5. Hinge point bolt retaining nut omitted causing a split flap condition.

6. 12-inch steel rule was left in the arresting gear control area.

7. Murphy's Law—Crew reversed leads to sump warning light.

8. Improper procedures used to drop-check the landing gear causing D damage.

9. Crewman installed sequence valve improperly. D damage.

10. Crewman inflated raft while removing it from the aircraft. E damage.

T-28

1. Engine cowling lost in flight due to failure to engage fasteners. E damage.

E-1B

1. Escape hatch lost due to failure to engage fasteners and to check hatch for security.

2. Improper adjustment of emergency disconnect plunger release pin jam nut prevented a disconnect of faulty CSD. F damage.

C-121

1. Murphy's Law—Elevator trim tab was installed in reverse—flight aborted.

2. Alternator cover struck no. 2 propeller as a result of improper security. E damage.

3. Propeller feathering line was left loose causing loss of oil and flight abort.

H-37

1. *Failure to install a cotter pin* in throttle linkage nut and bolt resulted in loss of power and forced landing.

UH-2

1. Improper bridle hook up on drone. E damage.

H-3

1. Repeated use of manual override switch to seat hoist cable which was corroded resulted in cable failure and D injury.

2. Improper rigging of speed selector lever resulted in an uncontrolled hot start and engine change.

3. Failure to keep tail rotor shaft locked resulted in E damage.

4. Failure to install locking mechanism for stator vanes caused overtemperature and turbine seizure.

5. Failed to remove rags from oil cooler on preflight.

6. Failed to check oil in transmission. E damage.

7. Towed aircraft with locked tail wheel. E damage.

8. Crewman left tool on the rotor head. E damage.

H-13

1. Failure to perform dye penetrant inspection of the tail rotor blades. C damage.

H-34

1. Failure to secure and visually check external cargo hook resulted in loss of cargo.

2. Improper fuel mixture linkage adjustment resulted in backfire, fire and E damage.

3. Pylon was dropped to deck when folded due to lack of coordination. E damage.

H-25

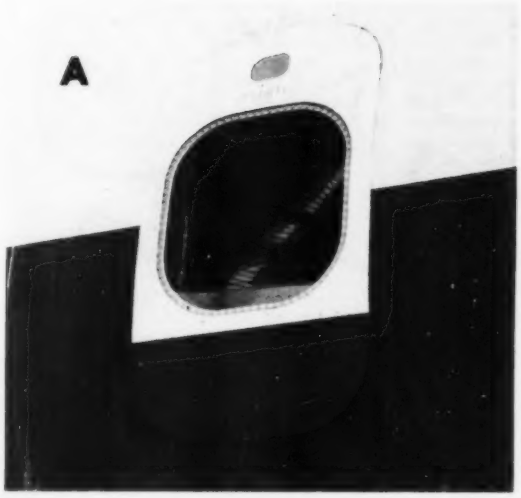
1. Leaving a mallet on the rotor head during engagement resulted in E damage.

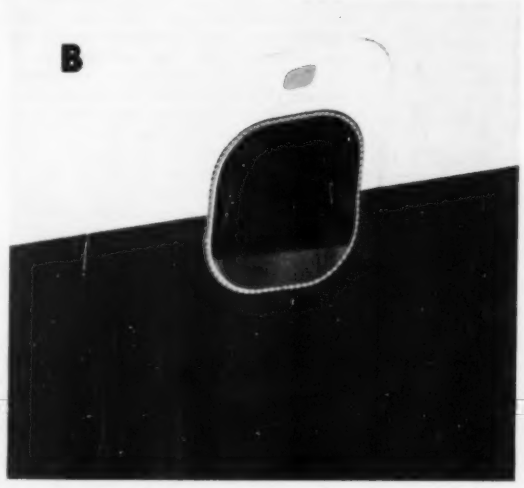
2. Upper bearing screws were not lockwired, allowing separation of screw jack. A damage.

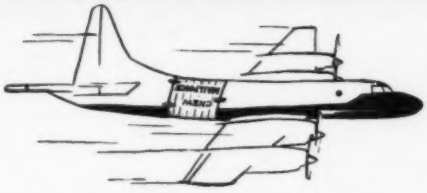
H-37

1. Plane captain failed to engage lock pins on door. E damage.

MURPHY'S LAW *







*If an aircraft part can be installed incorrectly, someone will install it that way!

DURING calendar inspection of a P-3A it was noticed that both mid-fuselage Emergency Exit Doors were inadvertently swapped.

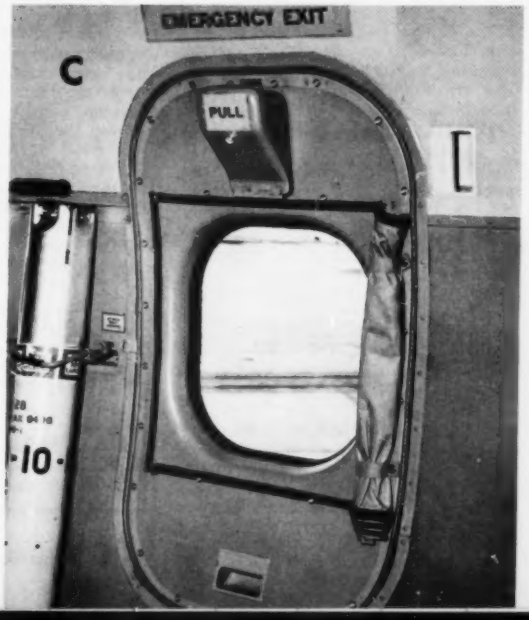
While limited testing indicated that cabin pressurization did not degrade, proper fitting and fastening of exits could be affected by the swap, and therefore a hazardous situation could result.

The swap was detected through the exterior paint scheme (see photos A and B). No clue was present from the inside of the aircraft, photo C, with handle covers in place. With the handle covers down, small decals are visible.

Recommend a better means of internal identification of the two mid-fuselage emergency exit doors. Suggest interim measure marking of exit doors "RH" or "LH" with reflective tape.—LT. E. E. HANSON, VP-46 SAFETY OFFICER

▶ *New hatch assemblies are the same and can be interchanged. But, it is possible that doors would not fit properly if interchanged after the aircraft has been in service due to normal "racking" of the airframe that occurs with age.*

Concur in the recommendation and further recommend that maintenance crews and flight crews be so advised. Meanwhile NASC has advised prime O&R activities of this potential hazard.—Headmouse



Letters

Want your safety suggestion read by nearly a quarter of a million people in naval aviation? Send your constructive suggestions to APPROACH.

Altitude Correction

FPO San Francisco—The APPROACH magazine is held in the highest esteem by all of us local-mouses. And while we acknowledge it to be the finest aviation safety publication in the world, we feel we have to question the mathematical agility of your staff-mice. We refer to "Leisurely Night Launch" on page 18 of your April 1964, edition.

Being helicopter drivers and some what more intimate with the lower altitudes of the flight regime than our stiff-winged contemporaries, we honestly feel that an altitude of "ten feet above the water" is more in the order of flight level .01, vice the published ".001."

A new form of "Murphy"???

ROTORMOUSE

• Thank you for your letter bringing to our attention the error. The mathematics were found to be incorrect.

In recalculating the flight level it appears that 10 feet altitude would be flight level .1 vice the published .001 and your corrected .01.

Here's to more accurate low level altitude control on both our parts.

Builds Warning Device

San Diego—I have designed a device that may be useful in warning the helicopter pilot that he is approaching the mechanical limits of his throttle control (full power). This device requires 28 volts while in operation, and consists of a transistorized audio oscillator, a flasher relay, a micro-switch, a cam, and the present ICS system. These items appear in the aviation supply system.

The cam, which is mounted on the throttle control shaft close, the micro-switch mounted on the collective housing when a predetermined throttle setting has been reached. This applies 28 volts to the flasher relay, which in turn supplies short, timed, voltage bursts to the oscillator circuit, causing repeated beeps with a distinctive sound, to be heard on the ICS system. This warns both pilots that they are operating in the critical range.

This device can be adjusted to begin operating at any desirable setting and will continue until the power has been reduced below that point. This circuit requires no warm up period, and draws no current until the critical range is entered and the micro-switch has been closed. The frequency and tone of the signal, as well as the volume, can be adjusted by the pilot during the preflight before the engine has been started.

I have constructed a working model of this system on a bread board. The complete device weighs less than a pound, and should require no changes in the present helicopters other than installation. I have turned the device over to the maintenance officer of our squadron (VAW-11), in case any helo outfits are interested.

ROLAND R. PINEAU, AT1
Avionics, VAW-11

• Your device is most interesting. As you know power management in helicopters is one of our major problems. Such a device could conceivably help the pilot manage available power more efficiently. Since NASC is not in the research and development business your letter was forwarded to the Marine Corps Development Center at Quantico with a recommendation your device be evaluated. Your professional interest in aviation safety is commendable.

APPROACH welcomes letters from its readers. All letters should be signed though names will be withheld on request. Address: APPROACH Editor, U. S. Naval Aviation Safety Center, NAS Norfolk, Va. Views expressed are those of the writers and do not imply endorsement by the U. S. Naval Aviation Safety Center.

Right Angle

Springfield, Va.—In the March issue of APPROACH the question of how to carry a flashlight is discussed. I had tried using the loop around my neck as well as tying a line to the mae west. My solution was a simple one that I prefer to the loop. I went to the supply sergeant and obtained a right angle flashlight with a spring clip located for upright installation. Now, I don't have the loop (although the base of the light permits such an installation) and the flashlight clips to the mae west or torso harness and more importantly, permits a hands-off light for electrical failures. The light takes a standard red lens and is easier to locate when needed.

If the supply office doesn't have such a light, they can be ordered easily or

can be purchased at any store which sells Boy Scout supplies.

HENRY R. VITALI
CAPT, USMC

• Thank you for your letter. We have received a similar letter from LT J. A. Schmidt, VS 934 NAS Willow Grove.

If you want a right angle flashlight order either: type I, Style 2, Regular Standard, Right Angle 2-cell, MX-991/U, FSN 9Y-6230-264-8261 or Type II, style 2, explosion-proof right angle 2-cell, MX-212/U, FSN 9Y-6230-243-6069.

For Nets

Jacksonville, Fla.—Keeping carrier airplanes out of deep, salt water requires not only the nicest timing and ability on the parts of pilots, crewmen, deck handlers, et al, but provision and maintenance of adequate facilities and safety devices are utilized incident to flight operations.

Refer October issue of APPROACH, page 7; observe the photograph in lower right-hand corner . . . . . note the lack of a safety net on the round-down at the end of the angled deck. One is led to wonder if this particular carrier has safety nets affixed across the ramp at the stern, and across the bow for the axial deck; and if they have it in for their flight deck crews and/or plane captains.

Hurrah for that plane captain with the hairtrigger reaction.

ANYMOUSE

Keep Cool

Meridian, Miss. — The following is offered as a sequel to an article headed "Exit Troubles" on page 35, of the December 1963 issue of APPROACH.

After an aborted takeoff, unsuccessful double barrier engagement, subsequent nose gear collapse, and ruptured external 450 gallon drop tanks, and fire, the pilot of a RF-84F began executing final steps of checklist items for emergency ground egress. Upon opening the canopy, flames entered the cockpit and the pilot began to receive singeing burns while unharnessing himself. He reached up in the flames and closed the canopy, removed all equipment except his helmet as the flames began to cover the entire cockpit section, opened the canopy, and made a record breaking standing broad jump and 20 yard dash through the flaming JP-4. It pays to keep a cool head in a hot situation.

JOHN G. GEMENY, MAJOR
153RD TACRECONSQDN ANG

Deadlines & Departures

This month there's new blood aboard to help steer Approach magazine—LCDR Richard A. Wigent, succeeds LCDR James R. Foster as managing editor.

LCDR Foster a veteran of two tours with VF-33, has now reported to a Destroyer Flotilla as Staff aviation officer. An ASO graduate and PG school alumni like his relief, Jim Foster earned his fleetup from Flight Ops Editor to managing editor with a series of hardhitting tailhook articles. Particularly noteworthy were February 1963's RAMP STRIKE and GETABOARDITIS of January 1964.

LCDR Wigent is the sixth exec of Approach. He brings a broad and excellent background—including duty as a flight instructor, carrier CIC, as well as two fighter and one attack squadron tours.

Bouquets

NAS Willow Grove — I think APPROACH is one of the finest and most informative digests of its kind. The range of information leaves little to be desired. I have personally gained much knowledge about my job that I don't think I would have gained otherwise.

By conning the articles each month I have learned to understand and appreciate the job of the other guy. . .

W. C. GEISSLER
CRASH CREW CHIEF

Annual Index Omitted

In prior July issues Approach has printed a cumulative index covering the previous fiscal year. Due to a shortage of space the yearly index is not included in this issue. The current and Future indexes will be released as part of the aviation Safety Officer's CROSSFEED packet.

Additional copies of the index will be available on request for libraries, manufacturers, and various non-Navy Government, industry and individual civilian and military subscribers. Merely address Commander, NASC, Attn: Safety Education Department, NAS Norfolk, Va. 23511.

OpNav 34P1 Out

Washington, D. C.—SecNav Notice 5100 of 15 April 1964 states that the responsibility for maintaining OpNav 34P1, "United States Safety Precautions Manual" will be transferred from the cognizance of the Chief of Naval Operations to that of the Chief of Industrial Relations and *dropped from fleet usage*, effective 1 July 1964.

The Notice also stated that investigation revealed the manual is not effective within the operating forces but with appropriate changes, is of value to shore activities.

Therefore, the Chief of Industrial Relations will:

1. Revise this manual to incorporate general safety precautions applicable ashore. Upon revision, maintain the manual in a current status and distribute it only to shore activities and fleet schools.

2. Change the title to "Department of the Navy Industrial Precautions."

3. CNO will develop and issue a separate publication to the operating forces which, as an index only, will compile and list subject matter and identifying designation, specific safety precautions issued by the Navy Department. For example, NavWeps 00-80T-96, "Aviation Support Equipment and Safety Manual."

PAUL B. FAY, JR.
UNDER SECRETARY OF THE NAVY

". . . and furthermore, Doctor, we'll have to cut out the between meal snacks."

approach VOL 10 NO 1

Our product is safety, our process is education and our profit is measured in the preservation of lives and equipment and increased mission readiness.

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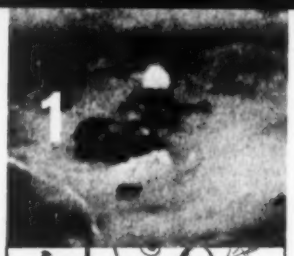

NavWeps 00-75-510

Page 6 Approach charts by L. R. Scott DM1

Page 8 Photo Courtesy CVA-60 (USS SARATOGA)

Page 16, 17 and 18 Charts and art by John Garner, Flight Test, NAS Patuxent River

Page 38, 39 and 40 Photos and art Courtesy **Design News**

Inside Back Cover, Photo Courtesy Grumman Aircraft Co.

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Progress Report

Each year the operational readiness of the Navy is increasing almost routinely as a result of procurement of new hardware and effective implementation of planned programs. The tangible improvements in new equipment and hardware are obvious; however, among our greatest efforts, but sometimes least obvious of our contributions to readiness, is our Aviation Safety Program . . .

The aviation safety program's purpose is to preserve equipment, safeguard airmen's lives and save aircraft without jeopardizing operational readiness. Every two new carrier fighters on the flight line approach the equivalent of an entire World War II air group in dollar cost and have almost the same potential. The loss of the combat potential of entire air groups is something we could not afford then, and it becomes quite evident that the aviation safety program must prevent it now.

Peculiarly, almost mysteriously, the results of an active aviation safety program sometimes appear to be in inverse proportion to the effort expended.

There have been occasions when the accident rate has spiraled upward right in the middle of an outstanding safety campaign thoroughly carried out by all hands. On other occasions one sees that the personal efforts of a squadron or group commander are apparently disregarded with no increase in accidents.

Sometimes it seems discouraging, but in aviation safety, with the net result of prevention of accidents and the safeguarding of lives, it is obviously all important that we must continuously improve our education, knowledge and attitude as professionals. This is the meat of the aviation safety program.

Each and every person must take an active part in aviation safety; it's an *all hands* effort. The pilots and crews who fly the planes, the maintenance men who labor long hours to maintain them and the myriads of support personnel who provide the essential services are together in that each group is the one that will either cause accidents or prevent them.—*Adapted from CNAVanTra Bulletin.*

LIFT and DRAG

THE

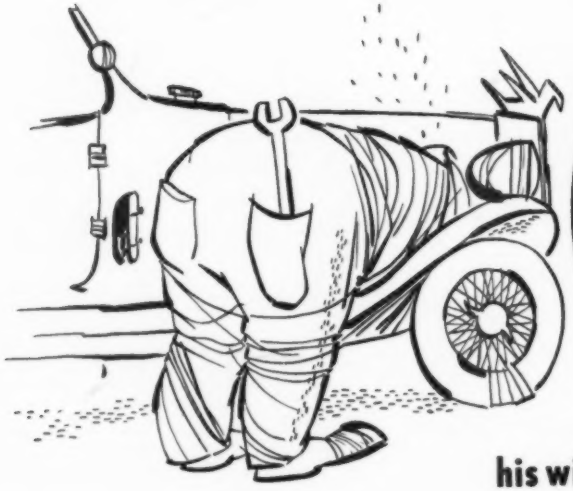
MECH

as seen by. . .

the safety officer

the maintenance chief

the pil



his wife

pil